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FY-80 Research Plan for IERL-Ci Activities at the T and E Facility

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Laboratory
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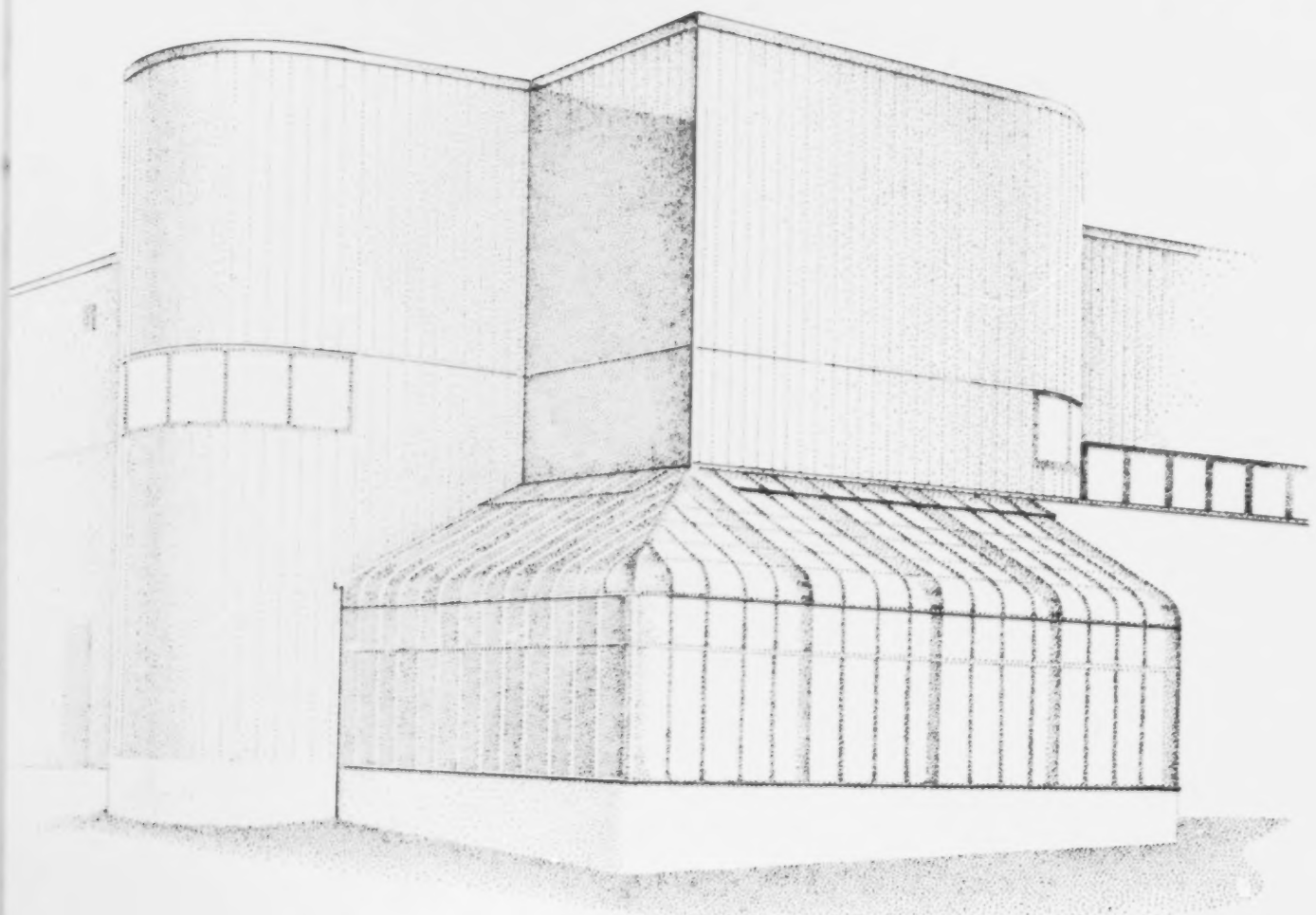

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16. ABSTRACT

The Office of Research and Development of the U.S. Environmental Protection Agency has recently begun (March 1, 1979) operation of a new facility in Cincinnati, Ohio known as the Test and Evaluation (T&E) Facility. The purpose of this facility is to house a variety of bench- and pilot-scale experiments in support of the various programs of the Cincinnati Environmental Research Center and the Newtorn Fish Toxicology Station. This report describes those projects the Industrial Environmental Research Laboratory-Ci plans to have active at this facility during FY-80.

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FY-80 RESEARCH PLAN FOR IERL-CI ACTIVITIES AT THE T&E FACILITY

INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

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INTRODUCTION

The Office of Research and Development of the U. S. Environmental Protection Agency has recently (March 1, 1979) begun operation of a new facility in Cincinnati, Ohio known as the Test and Evaluation (T&E) Facility.

The purpose of this facility is to house a variety of bench- and pilot-scale experiments in support of the various programs of the Cincinnati Environmental Research Center and the Newtown Fish Toxicology Station (NFTS). However, the Industrial Environmental Research Laboratory (IERL) and the Municipal Environmental Research Laboratory (MERL) manage the facility and are its principal users. Other users are the Health Effects Research Laboratory (HERL) and the Environmental Monitoring and Support Laboratory (EMSL), and it is anticipated that NFTS, HERL, and EMSL needs can normally be accommodated in activities as adjunct to MERL and IERL projects. Figure 1 shows the organizational relationship of the five (5) T&E Facility users.

The T&E Facility is located at the Mill Creek Sewage Treatment Plant of the Metropolitan Sewer District (MSD) of Greater Cincinnati. (Figure 2 shows the general location of this installation, and Figure 3 shows the T&E Facility as it fits into the MSD compound.) At this site, MSD operates a conventional primary/secondary treatment system for municipal wastewater and disposes of a variety of industrial wastes, some of which are incinerated. Therefore, the T&E Facility has ready access to various municipal and industrial wastewaters and sludges. The facility has approximately 24,000 ft^2 of usable pilot plant area which is highly flexible with regard to the types of studies which can be accommodated and it is contemplated that work will be performed in all areas of EPA's interests, viz., air pollution control, water pollution control, solid waste management, and toxic substances.

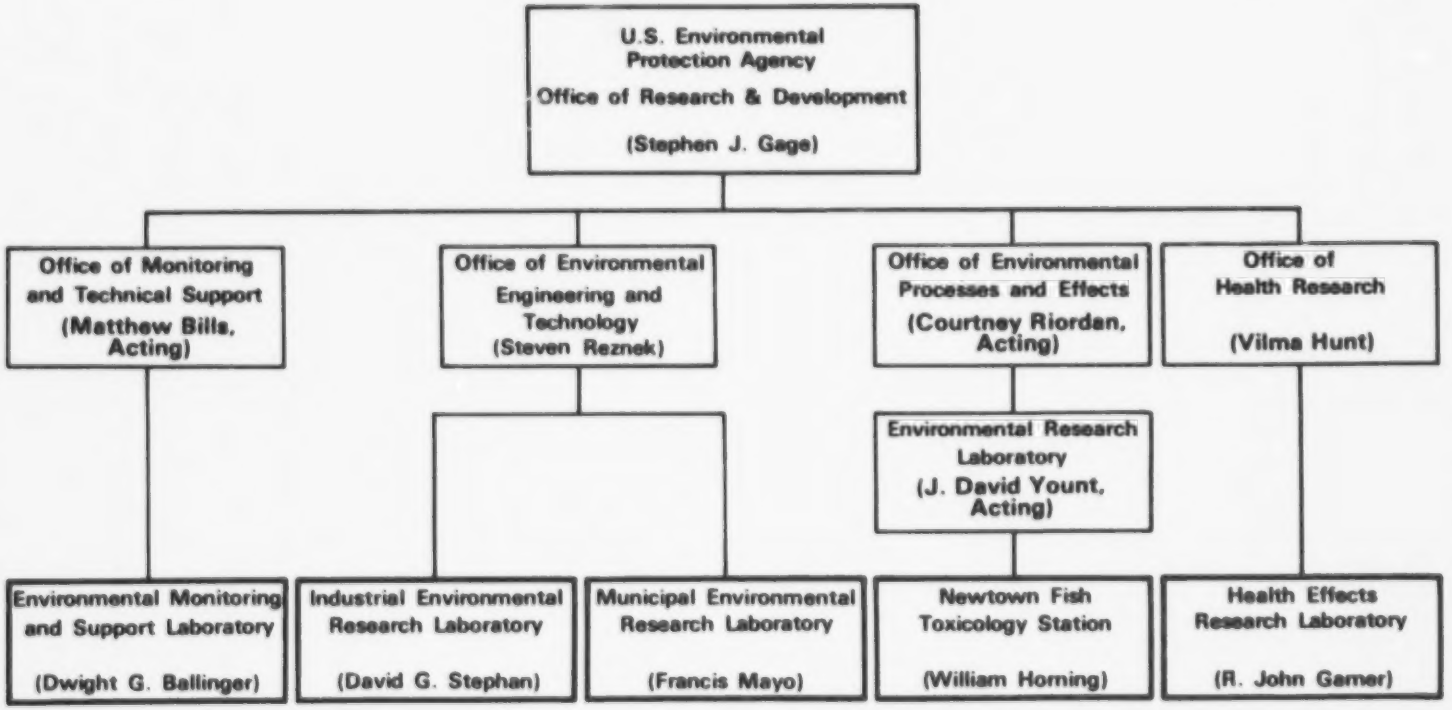

Figure 1. Organizational Relationship of the Five T&E Facility Users

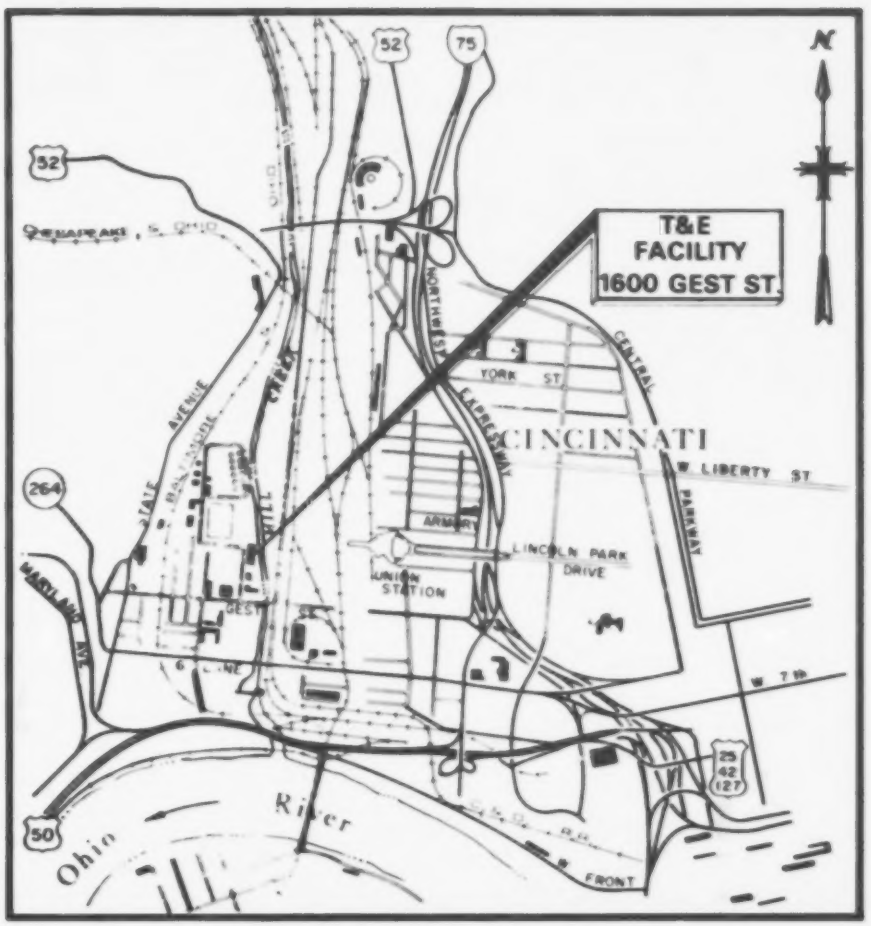

Figure 2. Vicinity Map of T&E Facility

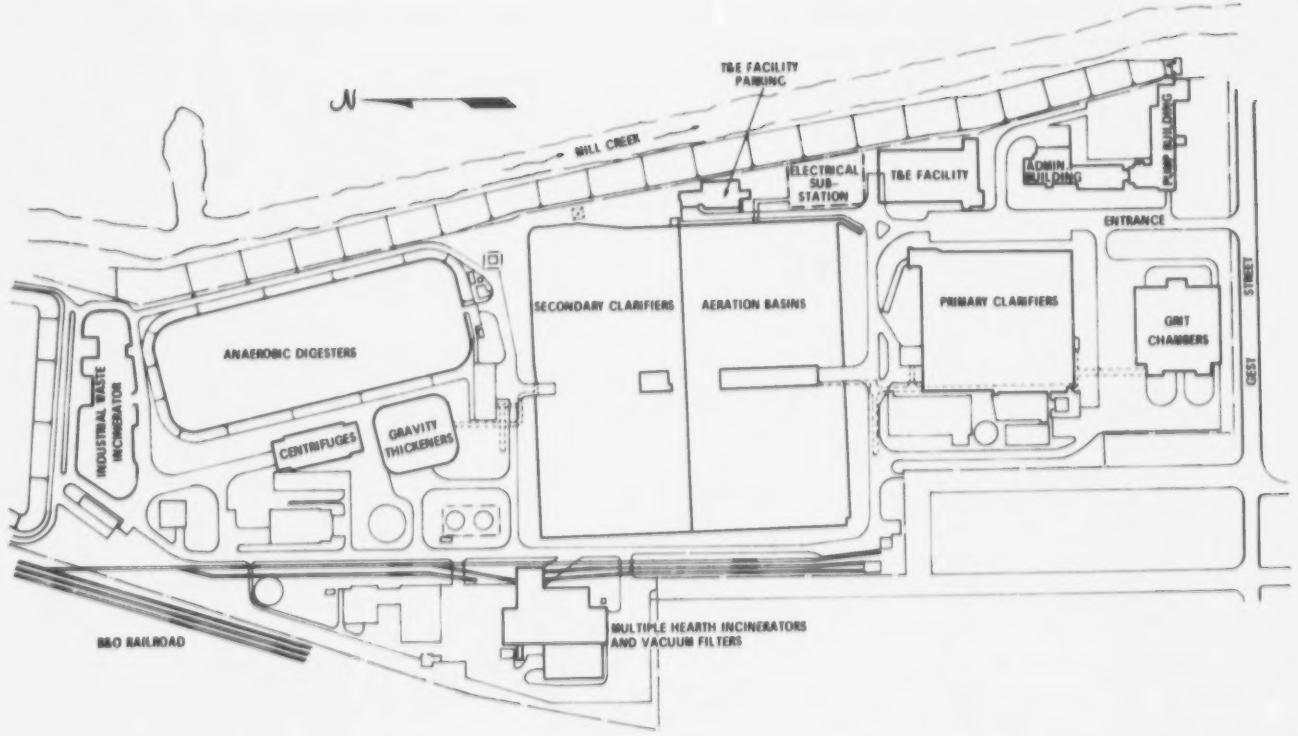

Figure 3: The T&E Facility as it Fits Into the MSD Compound

The building is a two-story metal structure composed of insulated metal wall panels attached to a superstructure of rolled structural steel sections. Figure 4 is an architect's rendering of this facility and Figure 5 shows the floor plan. Other physical features include:

- Single high bay experimental area (200' x 123') which is extensively equipped with services but has no permanent experimental apparatus
- Pipelines feeding various types of sewage and sludge from the Mill Creek Sewage Treatment Plant
- Greenhouse
- Laboratories for analytical support, chemical storage areas, offices, and building services (6,600 ft^2)
- Two five-ton bridge cranes for ease of moving equipment in and out
- Machine Shop

This report describes those projects which the IERL plans to have active through FY-80. The IERL is composed of three Divisions (Figure 6 provides an organizational chart for IERL) and a summary of its planned T&E Facility projects, sponsoring Divisions, and project officers follows:

	Title	Division	Project Officer
1.	Biological Treatment of Toxic Organic Constituents of Wastewater	IPCD	Brian Westfall
2.	Quantification of VOC Emissions from Cold Cleaning Degreasing Systems	IPCD	Charles Darvin
3.	Silicate Fixation of Metal Pollutants	IPCD	Fred Craig
4.	Use of Carbon Adsorption to Remove Toxic Organic Materials from Wastewater	IPCD	Brian Westfall
5.	Evaluation of Surfactant Scrubbing as a Treatability Method	IPCD	Charles Darvin

6.	Evaluation of Steam Stripping to Remove Toxic Organics from Wastewater	IPCD	Brian Westfall
7.	Leachability and Revegetation of Solid Waste from Mining	REHD	John Martin
8.	Pilot-Scale Conversion of Mixed Hazardous Wastes to Energy	ESECD	Walter Liberick
9.	The Adsorptive Characteristics of Coal: Control Technology for In-Situ Coal Gasification Effluents	ESECD	Robert Thurnau
10.	Shakedown of Various Unit Processes for the Treatment of Oil Shale Wastewaters	ESECD	Thomas Powers

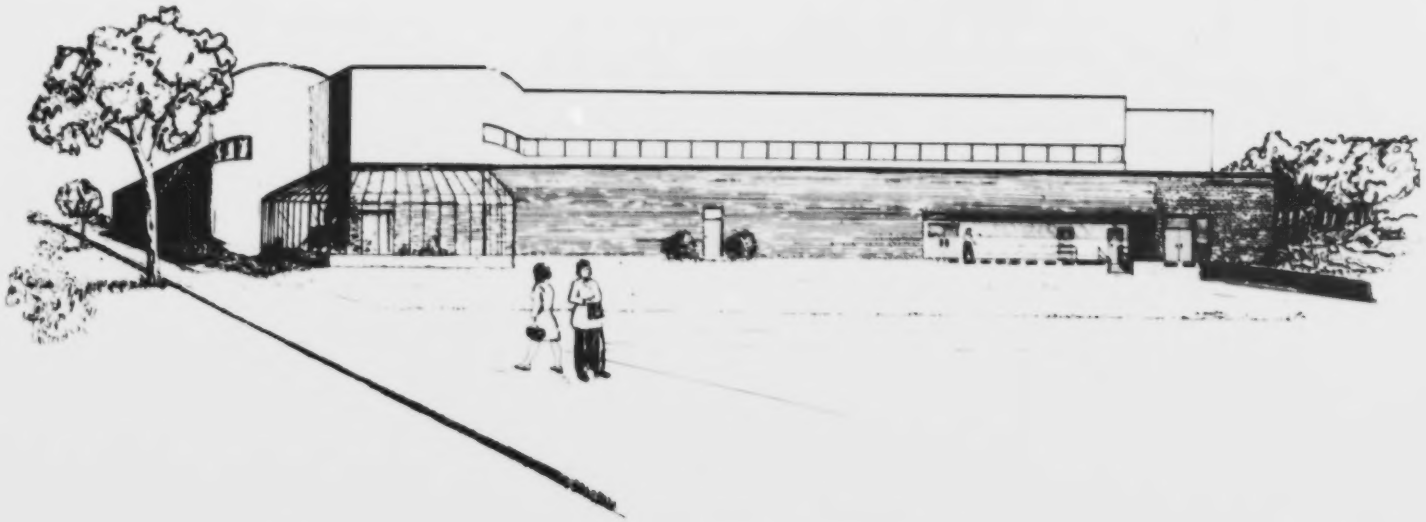

Figure 4. Architect's Rendering of the T&E Facility

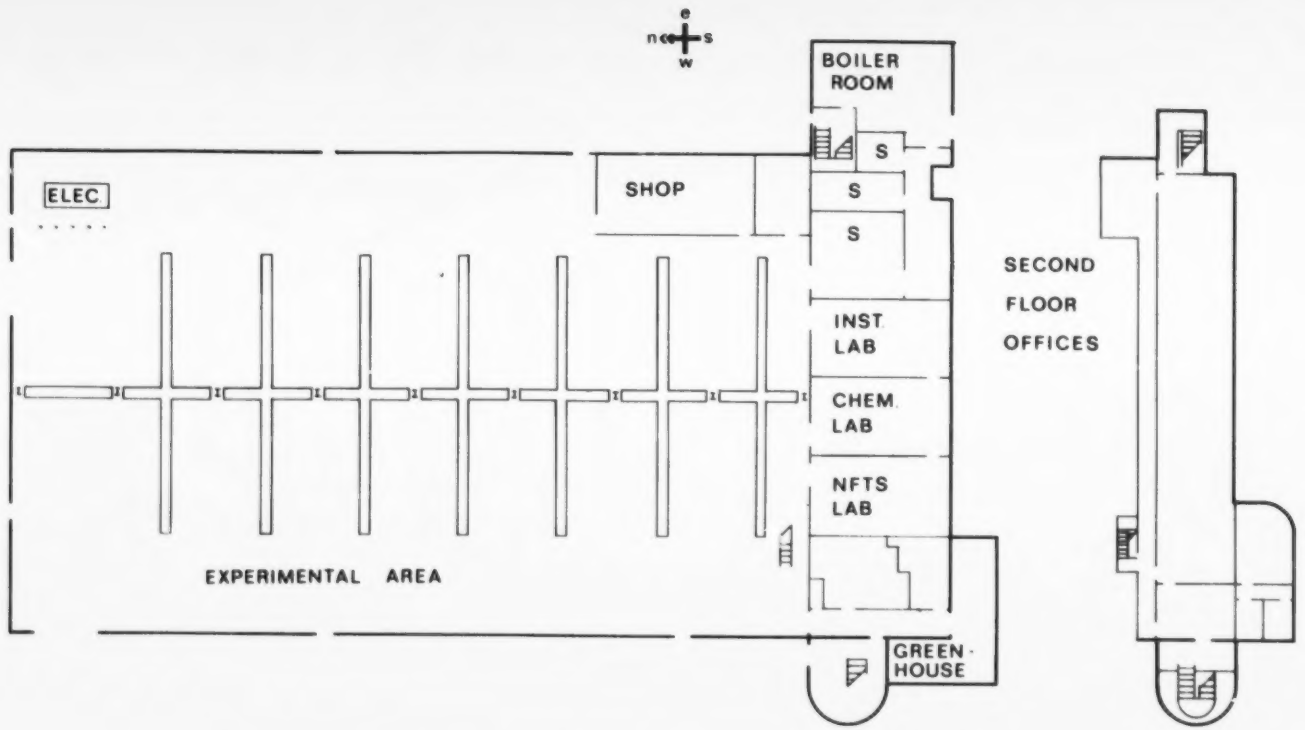

Figure 5. Floor Plan of the T&E Facility

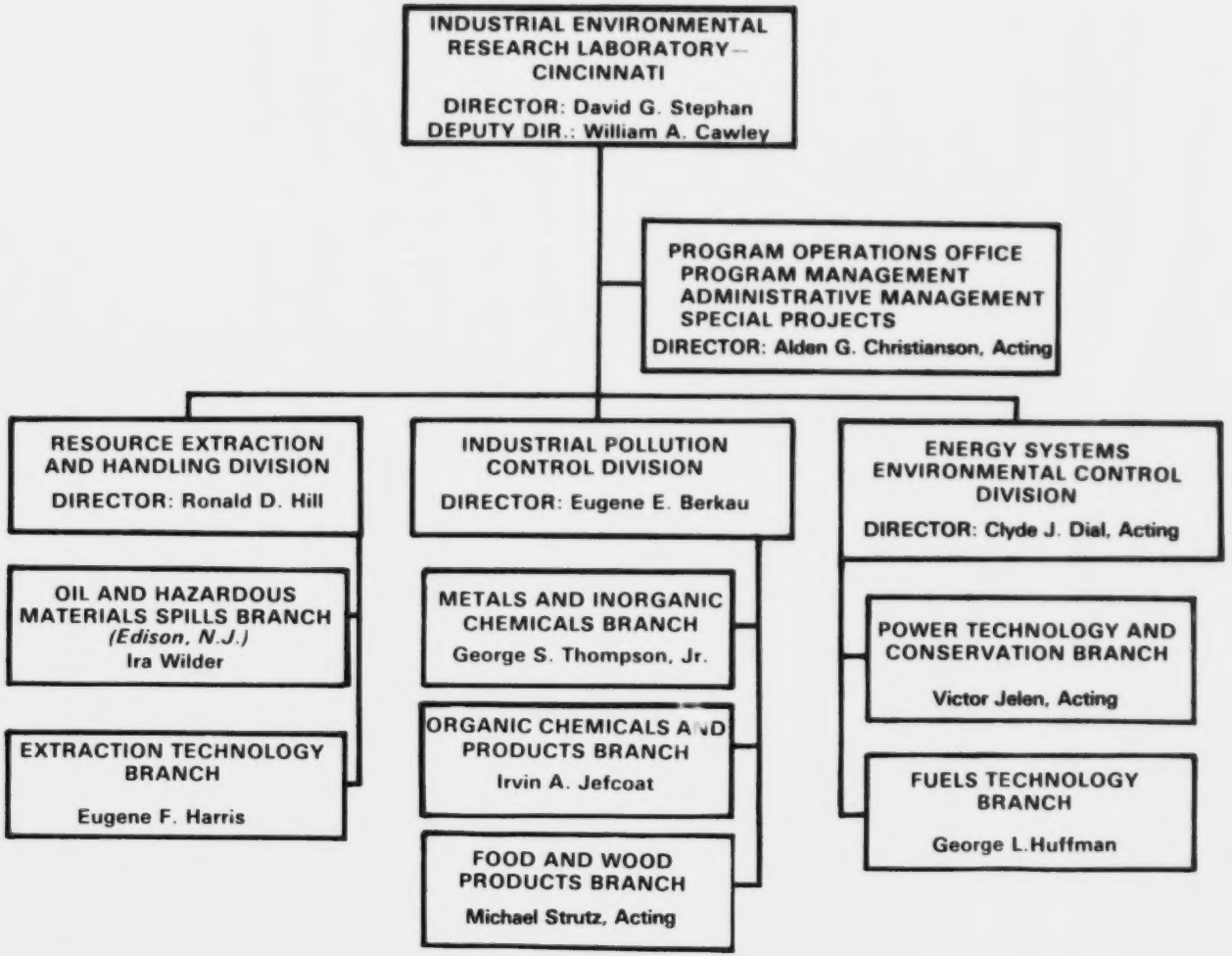

Figure 6: IERL Organizational Chart.

BIOLOGICAL TREATMENT OF TOXIC ORGANIC CONSTITUENTS OF WASTEWATER

Objectives:

The objective of this project is to determine the effectiveness of the activated sludge process, alone or in conjunction with powdered activated carbon, to treat various industrial wastewaters which contain toxic pollutants.

Fundamental Considerations:

Biological treatment has long been used as a treatment method for many industrial wastewaters. However, additional data are required to determine whether or not this type of treatment is applicable for wastewaters which contain various toxic pollutants.

Conventionally available biological treatment methods include biological filtration, activated sludge, oxidation ponds, RBC's, anaerobic digestion, etc. However, activated sludge is the most versatile of these methods since it can be tailored to handle a variety of wastes and to satisfy many different effluent requirements. Therefore, this program will investigate the application of the basic activated sludge system as a single unit process applied to various clarified industrial wastewaters or synthesized industrial wastewaters. The addition of powdered activated carbon directly into the aeration unit of the system will also be evaluated.

Procedure:

Two activated sludge pilot units with required auxiliaries will be constructed. These units will be portable such that they may be tested at the T&E Facility utilizing imported or synthesized industrial waste or at specific industrial plants utilizing a slip stream from the plant's effluent.

Each of these units will have a capacity of 190 gpd and the flow sequence is shown on Figure 8.

Specific industrial wastewaters will be selected for study based on expected composition of the waste, likelihood of it being treated biologically, and specific needs enunciated by the Effluent Guidelines Division. The initial phase of each test will require acclimating a sludge for the particular wastewater stream to be examined. Then samples from influent, effluent, and wasted sludge will be analyzed for specific toxic pollutants as well as for routine monitoring indicators such as BOD, COD, TOC, etc. In addition, the effect of varying such parameters as MLSS, liquid detention period, and carbon dosage will be evaluated.

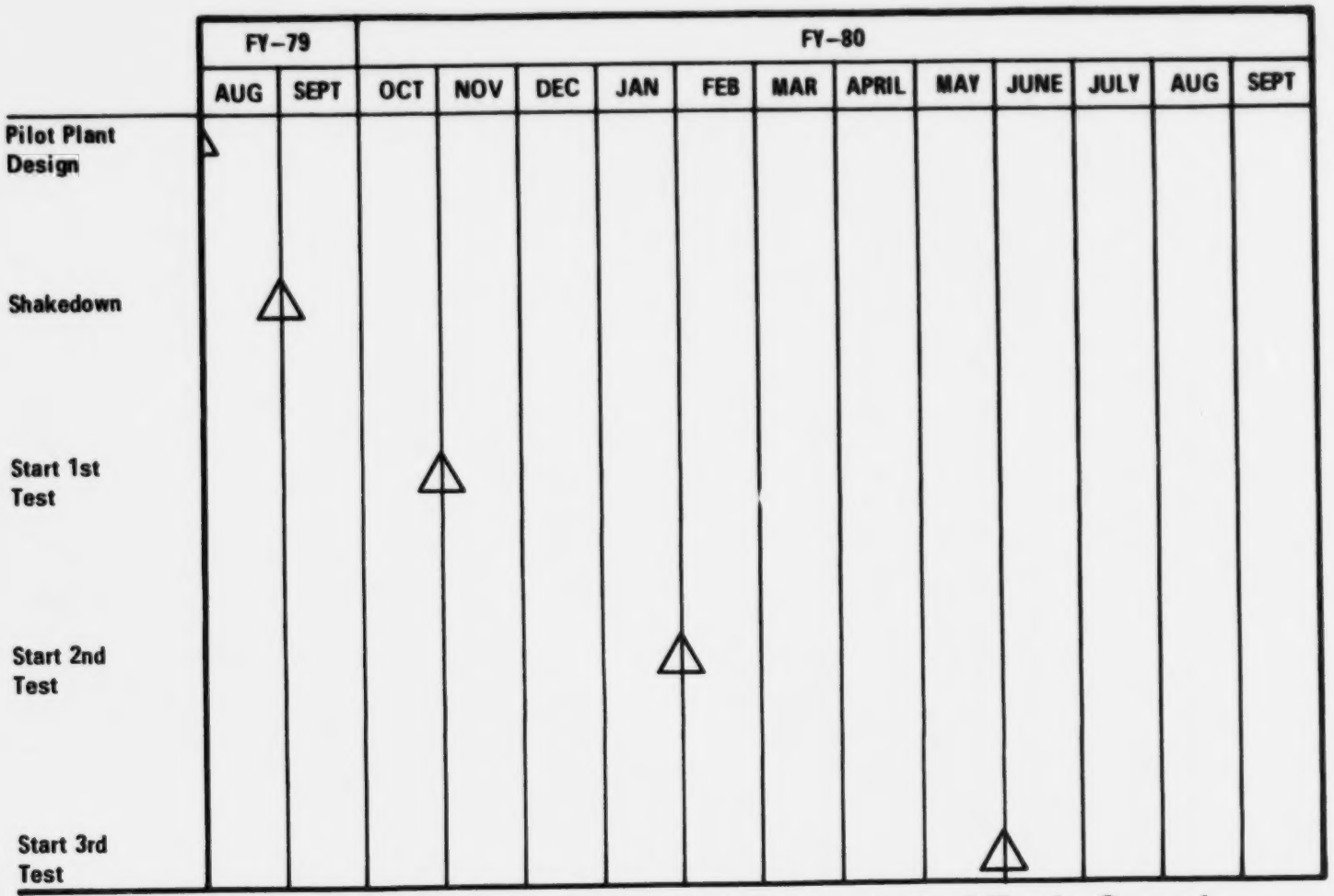

Figure 7: Project Schedule for Biological Treatment of Toxic Organic Constituents of Wastewater

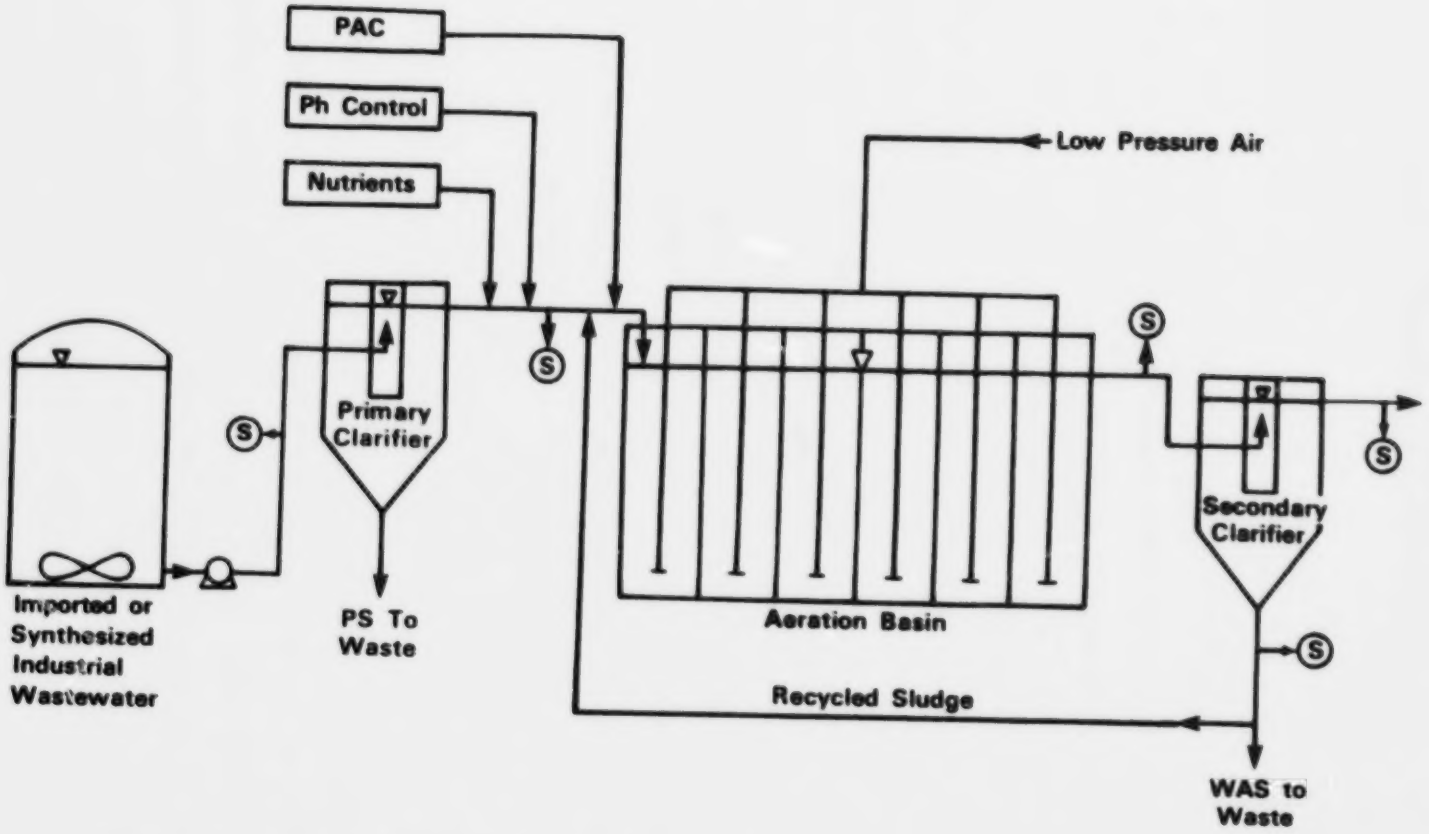

Figure 8. Flow Diagram for Biological Treatment of Toxic Organic Constituents of Wastewater.

QUANTIFICATION OF VOC EMISSIONS FROM COLD CLEANING DEGREASING SYSTEMS

Objectives:

The objective of this project is to quantify the VOC emissions from various cold cleaning degreasing systems and determine how these emissions are affected by the use of remote solvent reservoirs and spray nozzles and by varying freeboard height and ventilation.

Fundamental Considerations:

Degreasing operations employ various organic solvents and a certain amount of this material escapes into the atmosphere which creates a major source of air pollution. Preliminary information indicates that a significant amount of these emissions can be eliminated by increasing the freeboard height, the use of remote solvent reservoirs, controlled ventilation, solvent selection, and other equipment modifications. However, additional information concerning the amount of VOC emission reduction as a result of these measures is required to properly assess the impact of this approach.

Procedure:

Solvent emissions from a remote solvent reservoir with spray nozzles and a conventional cold cleaning degreaser system will be quantified. These systems will be placed in an enclosure which will be maintained at a negative pressure where a load of small parts will be automatically placed into the degreaser system and removed according to a set cycle. The quantity of solvent loss will be determined by weight loss and monitored with an infrared spectrometer. Freeboard ratios, ventilation and type of solvent (mineral spirits and standard solvents) will be varied, and the temperature, humidity, air flow and barometric pressure will be monitored.

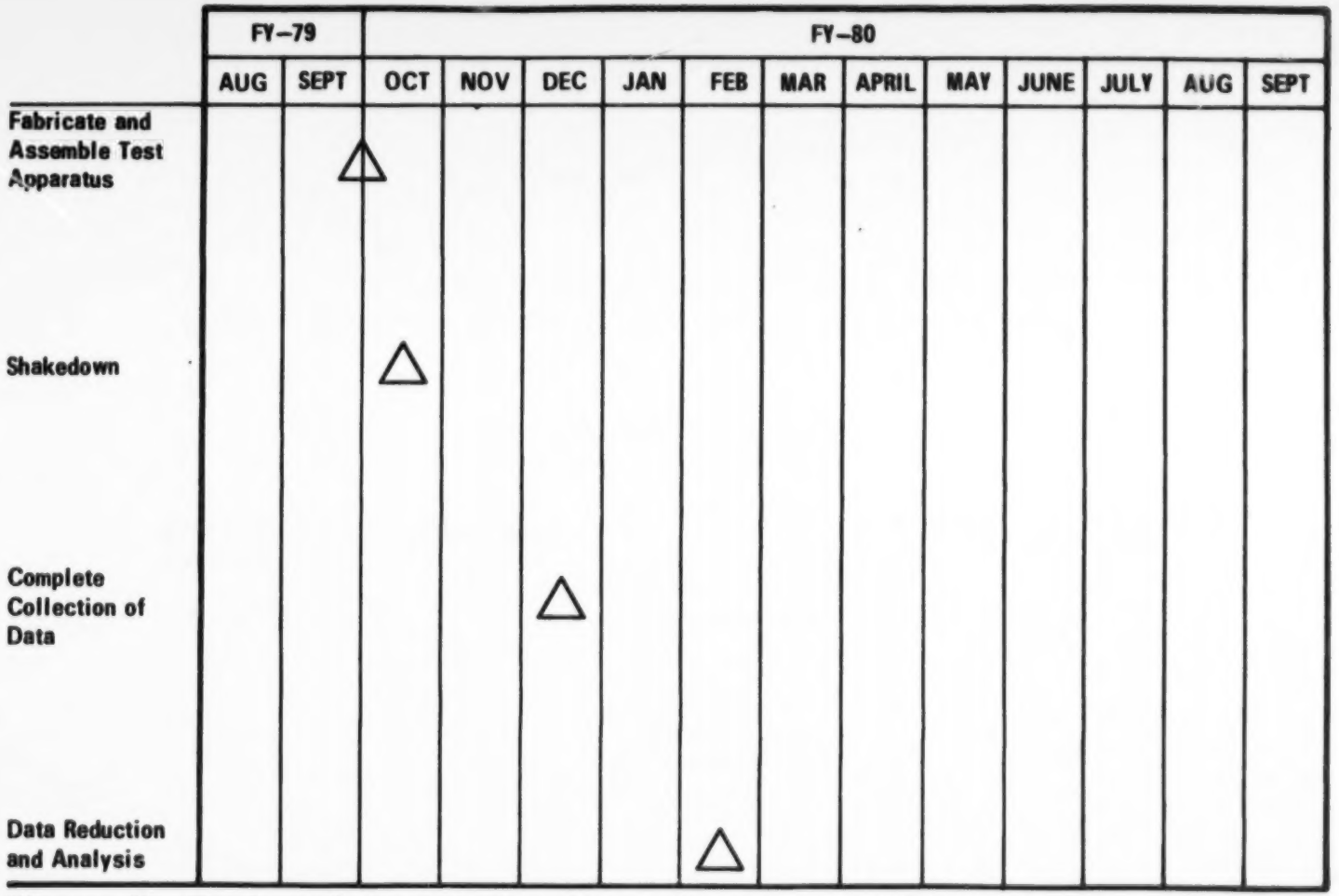

Figure 9: Project Schedule for Quantification of VOC Emissions from Cold Cleaning Degreasing Systems

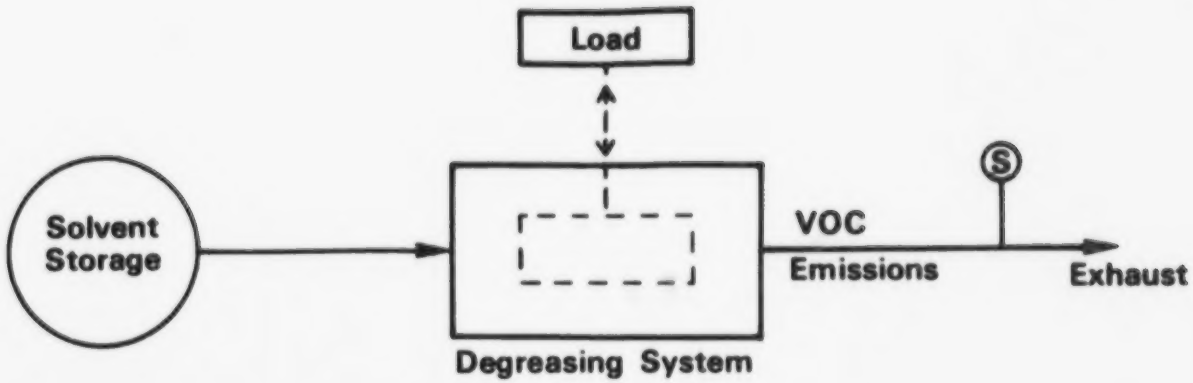

Figure 10. Flow Diagram for Quantification of VOC Emissions from Cold Cleaning Degreasing Systems

SILICATE FIXATION OF METAL POLLUTANTS

Objectives:

The objective of this project is to determine the effectiveness of silicate fixation of heavy metal waste as an alternative to disposing of hydroxide sludges.

Fundamental Considerations:

Precipitation using lime or caustic has been the basic approach for precipitating metals as hydroxides from industrial plating and non-ferrous wastewaters. Unfortunately, these sludges must be maintained at a pH near their point of formation in order to prevent leaching of the hydroxides. Further, the sludges must be dewatered to eliminate the bulkiness of the sludge. Unfortunately, much of the sludge volume is excess material (calcium, sodium, carbonates, etc.) carried into the precipitation process as materials burden and serves no useful purpose.

Silicate fixation can be used as a substitute precipitation process for removing heavy metals from acid wastewaters. The purpose of this test is to consider fixation as part of the OSW approach to managing hazardous waste. This study will be combined with the EPA/AES Sludge Characterization Study to generate data on handling of metal finishing sludges.

Procedure:

Wastewater samples will be collected from industrial plating and non-ferrous plants in the Cincinnati area and mixed with slag, cement, and lime to form a solid material similar to concrete. The metal pollutants will be fixed as silicates in this solid material which will be shipped to the Centec Laboratories in Virginia for analyses. Elutriates from the extraction procedure will be analyzed for metals.

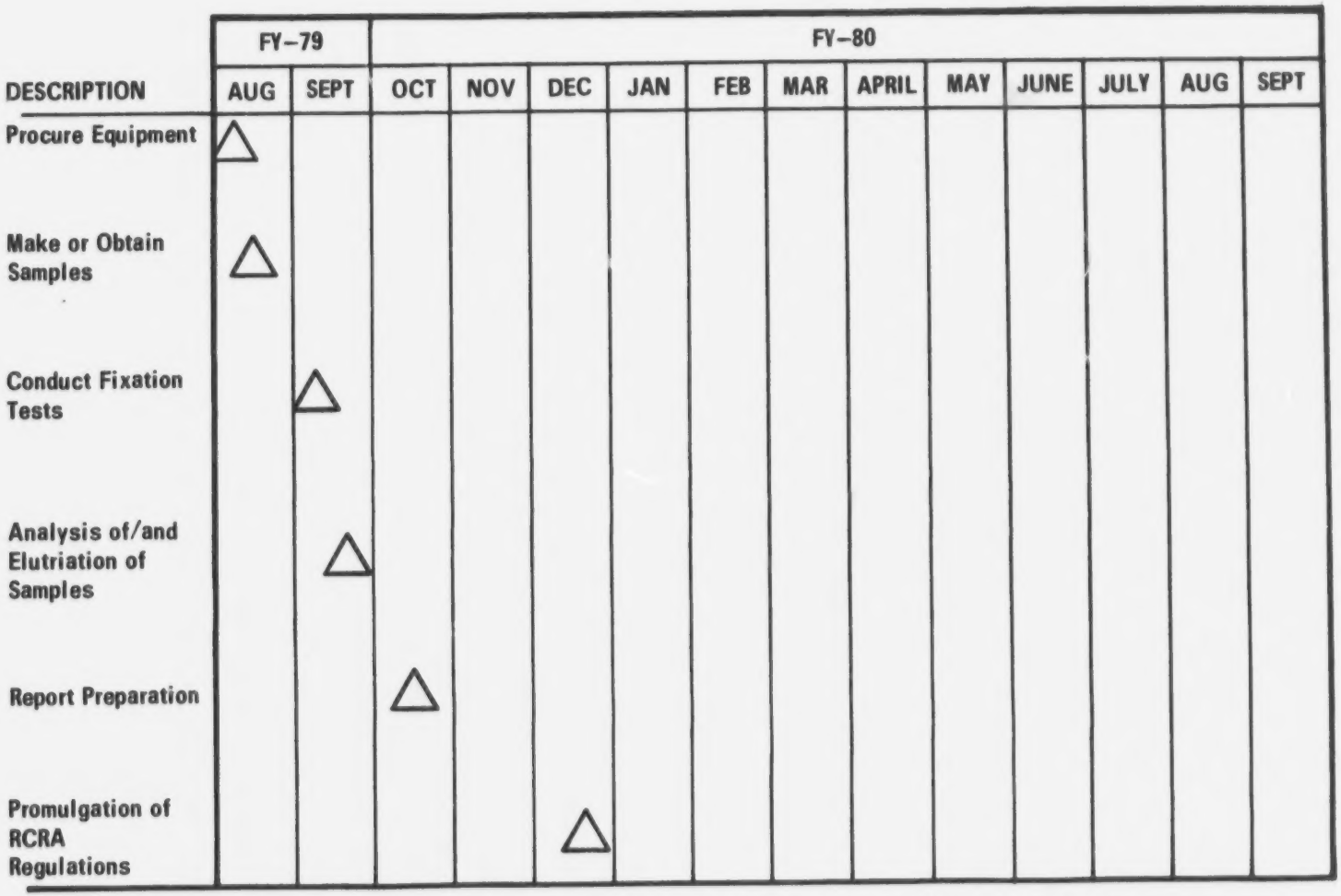

Figure 11: Project Schedule for Silicate Fixation of Metal Pollutants

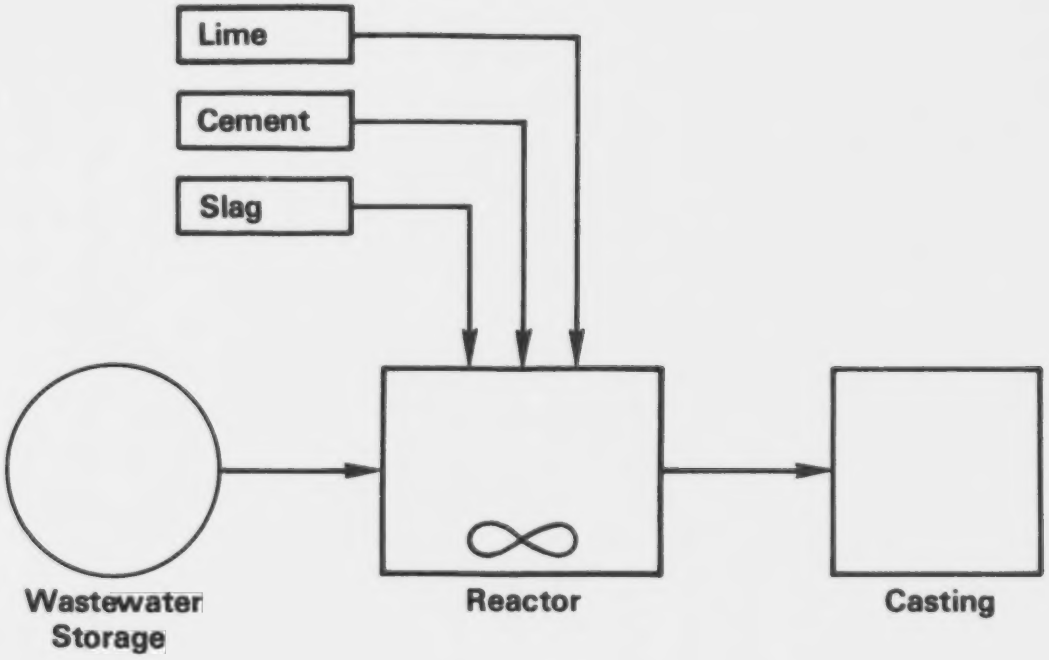

Figure 12. Flow Diagram for Silicate Fixation of Metal Pollutants

USE OF CARBON ADSORPTION TO REMOVE TOXIC ORGANIC MATERIALS FROM WASTEWATER

Objectives:

The objective of this project is to determine the effectiveness of carbon in removing organic compounds from industrial wastewaters.

Fundamental Considerations:

There are many existing examples which illustrate the feasibility of carbon adsorption systems to handle toxic organic wastes. Carbon adsorption has been shown to be an effective process in removing various and specific organics in both industrial and municipal applications such as those organics which affect the color, taste, odor, BOD, and COD of the wastewater. Carbon adsorption is predominantly used as a polishing process at a tertiary level of treatment.

Insufficient research exists concerning the efficiency of carbon adsorption in removing specifically the priority pollutants from actual industrial wastewaters. Therefore, additional information is required to determine whether activated carbon (powdered, granular, or both) can be utilized alone or in conjunction with other processes for the purpose of removing toxic organic pollutants from operating industrial plant wastewater streams.

Procedure:

Two skid-mounted multiple column carbon adsorption pilot units will be constructed. The columns can be used in parallel or series to achieve a range of flow up to 2,160 gpd.

The test program to evaluate the economic and technical feasibility of an activated carbon wastewater treatment system will consist of two phases.

These are, first, the development of batch isotherm data for determination of the degree of treatment that can be obtained using one or more different carbons, and second, operation of continuous flow pilot carbon column tests. The development of the isotherm data will be a laboratory bench test procedure utilizing an average of six different tests per waste stream and type of carbon tested. Each test series will be conducted for a minimum of one hour at a constant temperature. The samples will then be analyzed for the removal of a particular contaminant, TOC, and other applicable parameters.

The pilot plant dynamic flow column (Figure 14) tests will be conducted utilizing data developed from the isotherms. Effluent samples will be withdrawn from each sample port on either a time or throughput basis. The sampling schedule should provide approximately 18 to 20 samples per day of pilot plant operation. Five to six samples would be analyzed for the toxic pollutants with the remainder analyzed for a particular contaminant such as TOC, COD, and other applicable parameters.

Allowance will be made in the design and configuration of the system for eventual field testing of the facility at specific industrial sites in the manner described above. This will enable the testing of industrial waste streams under actual conditions.

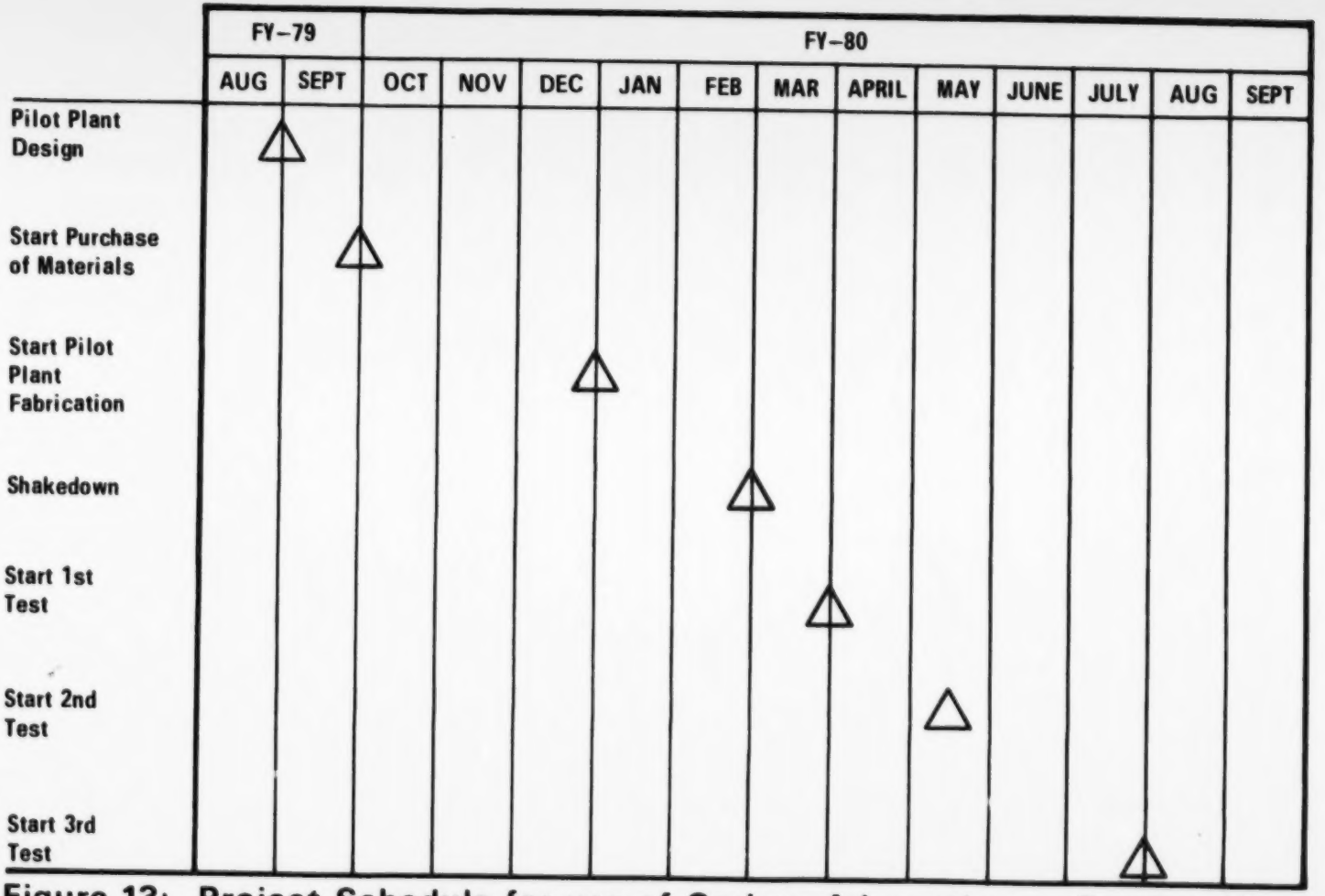

Figure 13: Project Schedule for use of Carbon Adsorption to Remove Toxic Organic Materials from Wastewater

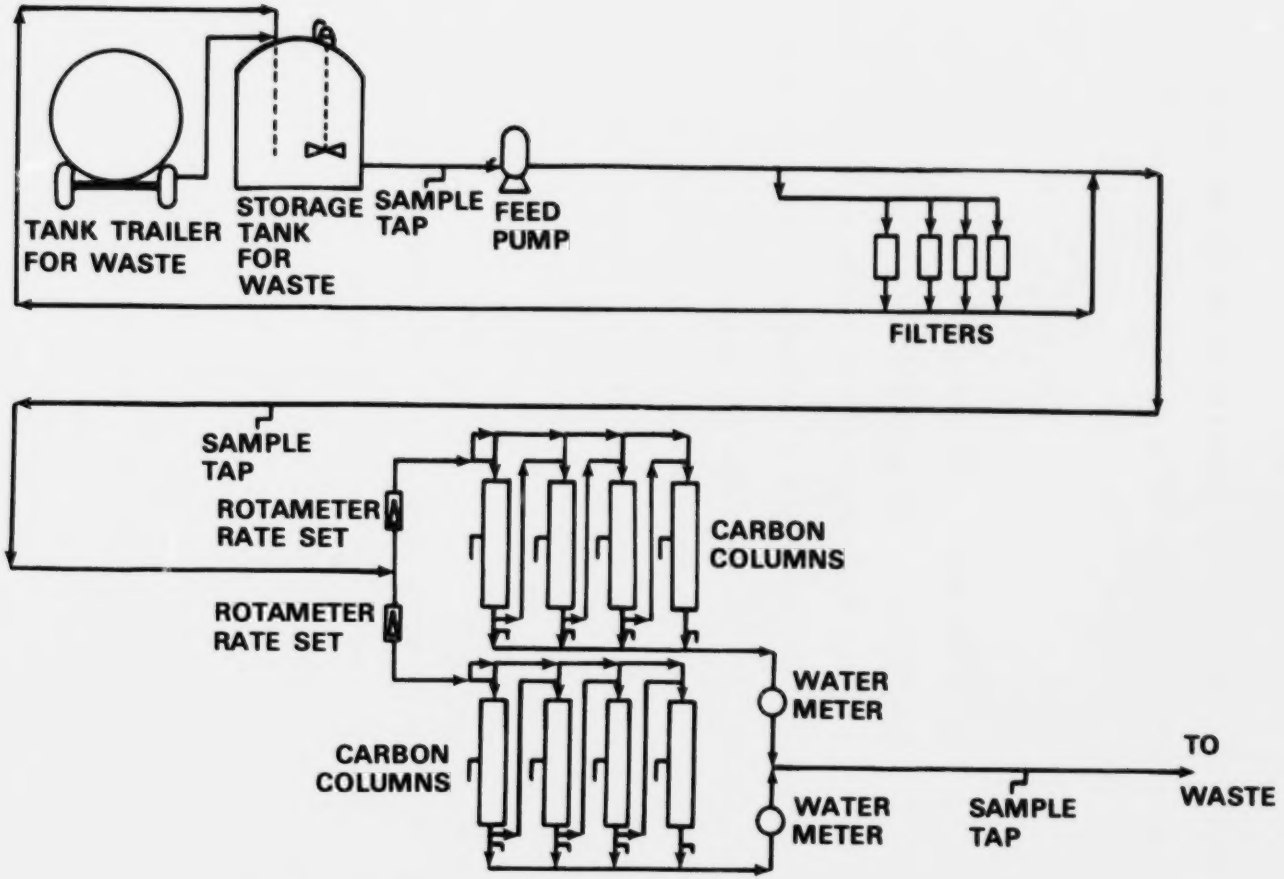

Figure 14. Flow Diagram for Use of Carbon Adsorption to Remove Toxic Organic Materials from Wastewater.

EVALUATION OF SURFACTANT SCRUBBING AS A TREATABILITY METHOD

Objectives:

The objective is to determine the effectiveness of the surfactant enhanced scrubbing system to remove volatile organic compound emissions from metal finishing facilities.

Fundamental Considerations:

Metal painting spray booths utilize the evaporation of solvents into the atmosphere as an integral part of the painting process. The ventilation of the spray booth results in a high volume of low concentration VOC emissions. They are largely insoluble in H_2O but when a surfactant additive is used, they become soluble and may be scrubbed from the gas stream.

Laboratory- and bench-scale investigations on the potential of the surfactant scrubbing concept have been conducted and it is now time to design a pilot system and enter an engineering development stage of this process.

Procedure:

Design and construction of the experimental apparatus will be performed under contract by Ebon in Newark, New Jersey. It will be skid mounted and easily transportable for evaluation at industrial sites. Initially, this system will be shipped to the T&E Facility where it will be tested to assure proper operation. It will then be taken to a metal finishing spray booth operation in the Cincinnati area for a 9 to 12 month evaluation period.

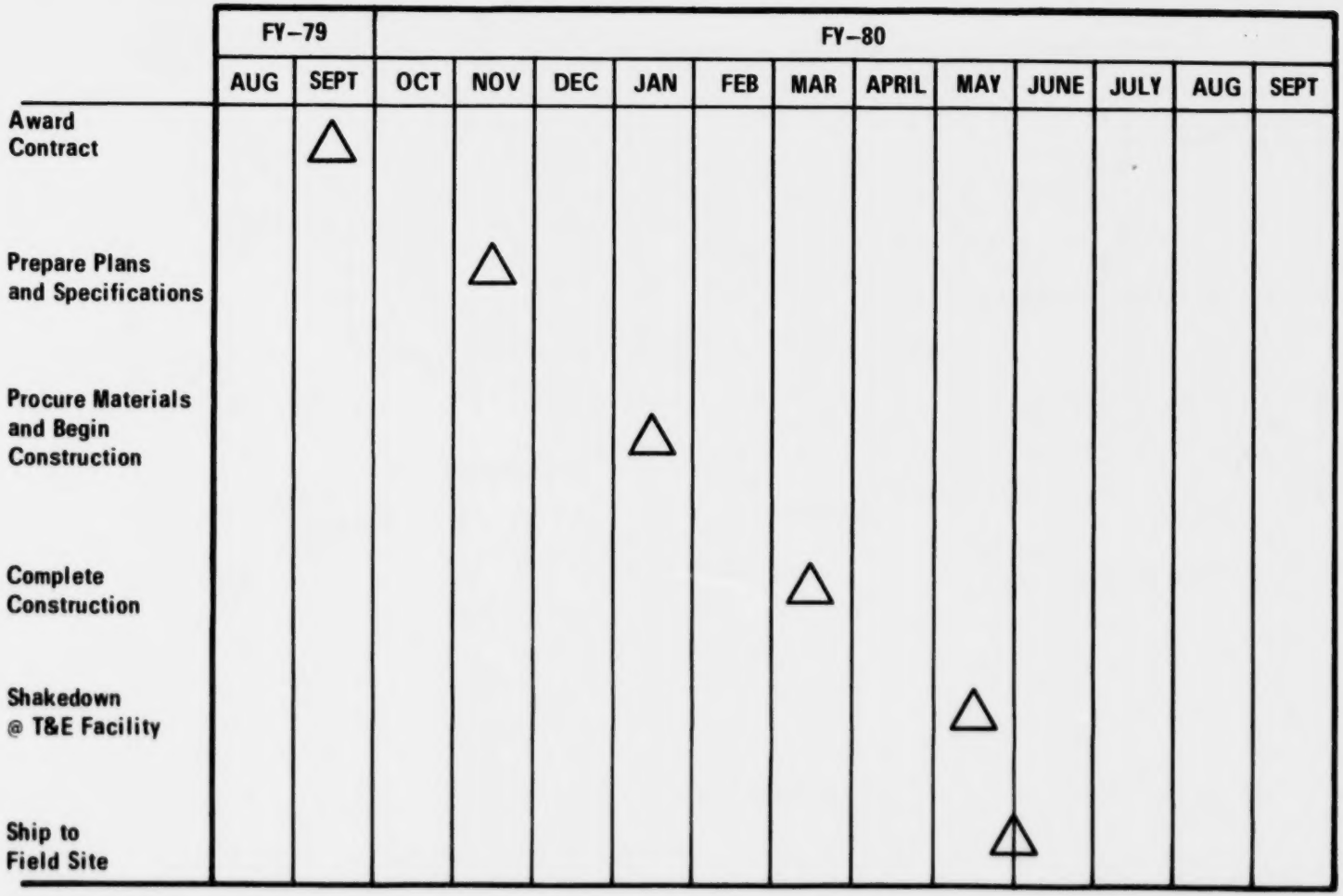

Figure 15: Project Schedule for Evaluation of Surfactant Scrubbing as a Treatability Method

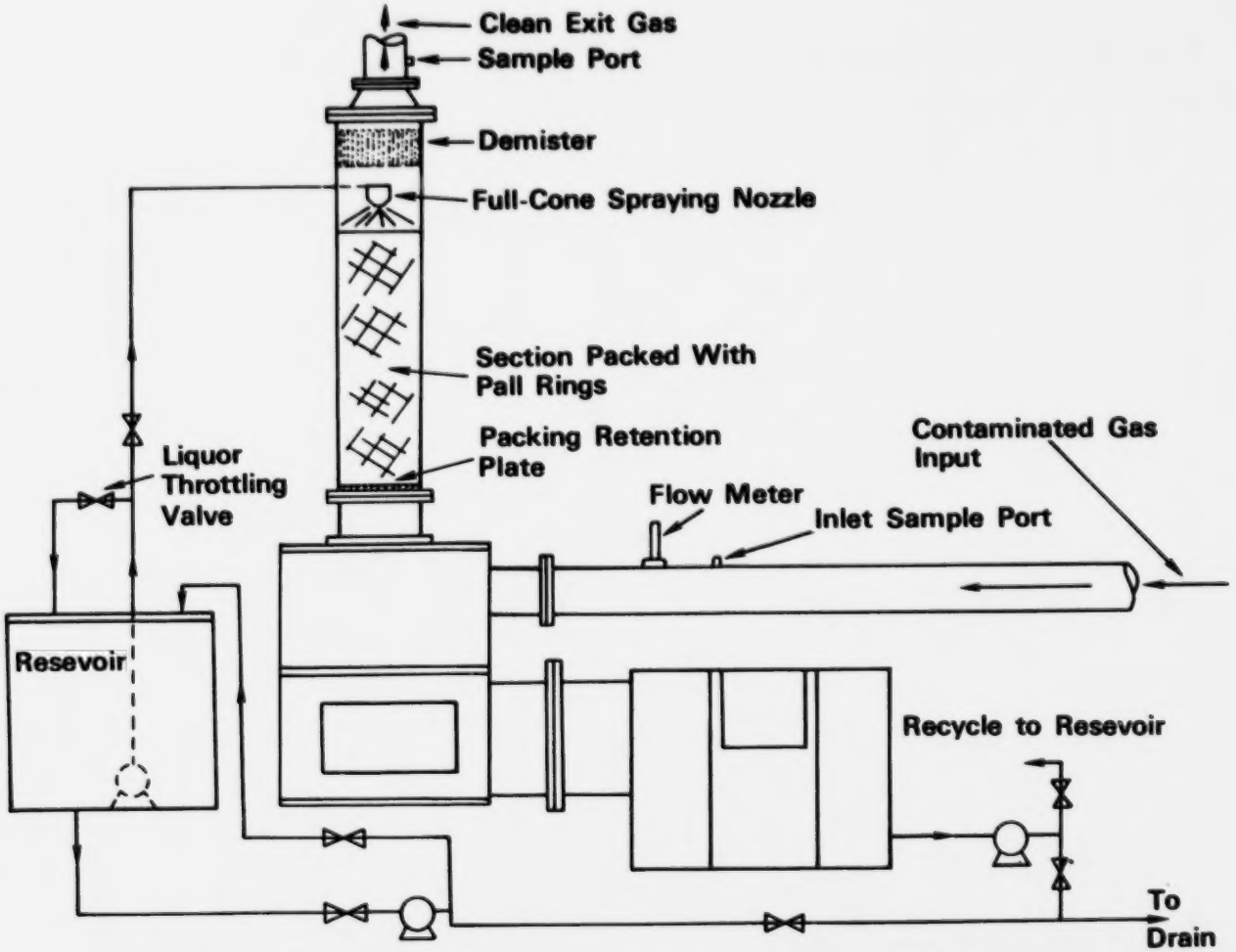

Figure 16. Flow Diagram for Evaluation of Surfactant Scrubbing as a Treatability Method.

EVALUATION OF STEAM STRIPPING TO REMOVE TOXIC ORGANICS FROM WASTEWATERS

Objectives:

The objective of this project is to evaluate the use of steam stripping as a method for removing organic chemicals from industrial wastewater streams.

Fundamental Considerations:

Many toxic pollutants are volatile chemicals, relatively insoluble in water, and can be separated from wastewater by distillation with live steam. Generally termed steam stripping, the process consists basically of heating the full volume of wastewater to its boiling point and condensing a fractionated portion of the resulting steam. Volatile chemicals will be selectively concentrated in the condensate. Since the pollutant is relatively insoluble in water, it will then separate as an immiscible liquid layer when the condensate is cooled, and can be removed from the water by decantation. Steam stripping is believed to be a feasible method for environmental control of many toxic and priority pollutant chemicals.

Although extensive engineering data are known concerning steam stripping of water/organic mixtures, these data are not applicable to low concentrations of these chemicals. It is not possible to extrapolate data developed for concentrated solutions to industrial waste streams, nor to predict mathematically the degree to which this technique will be feasible in this application. Most of all, it is not possible to establish the practical level to which the various toxic chemicals can be removed from wastewater through application of the steam stripping principle. Research is needed to extend the scientific knowledge of this technique and to establish its engineering feasibility.

Procedure:

A detailed design of the proposed pilot plant test unit is shown in Figure 18 which has a capacity of 720 gpd. A continuous small stream of water containing one or more toxic pollutants will be pumped through a heat exchanger and into the top of a sieve tray column. Steam from a boiler will be added to the bottom of the column. A portion of the steam will condense to supply sufficient heat to increase the temperature of all the water in the column to 100°C. Excess steam will rise from the top of the column, and be condensed and cooled with noncontact cooling water (once-through city water). The condensate will drain into a decantation tank. The water layer will be recycled continuously to the heat exchanger and the concentrated pollutant chemical or mixture of chemicals will overflow into a drum to be collected and recycled.

Bottoms from the column will flow by gravity through the shell of the heat exchanger, then through a vented overflow pipe and into a hold tank. After analysis, water from the hold tank will be pumped either into a waste pretreatment unit or, if no priority pollutant is present, into the city sewer.

Samples will be collected and analyzed and data will be obtained to define the efficiency of operation. The principal program output will be engineering data to permit specific design of similar units. A principal criterion of performance will be the ratio of overhead mass flow to fresh feed flow necessary to achieve acceptably low concentrations of toxic pollutants in the discharge water. Another most important output of the program will be the definition of the minimum practical effluent concentration of toxic pollutants achievable with this technique.

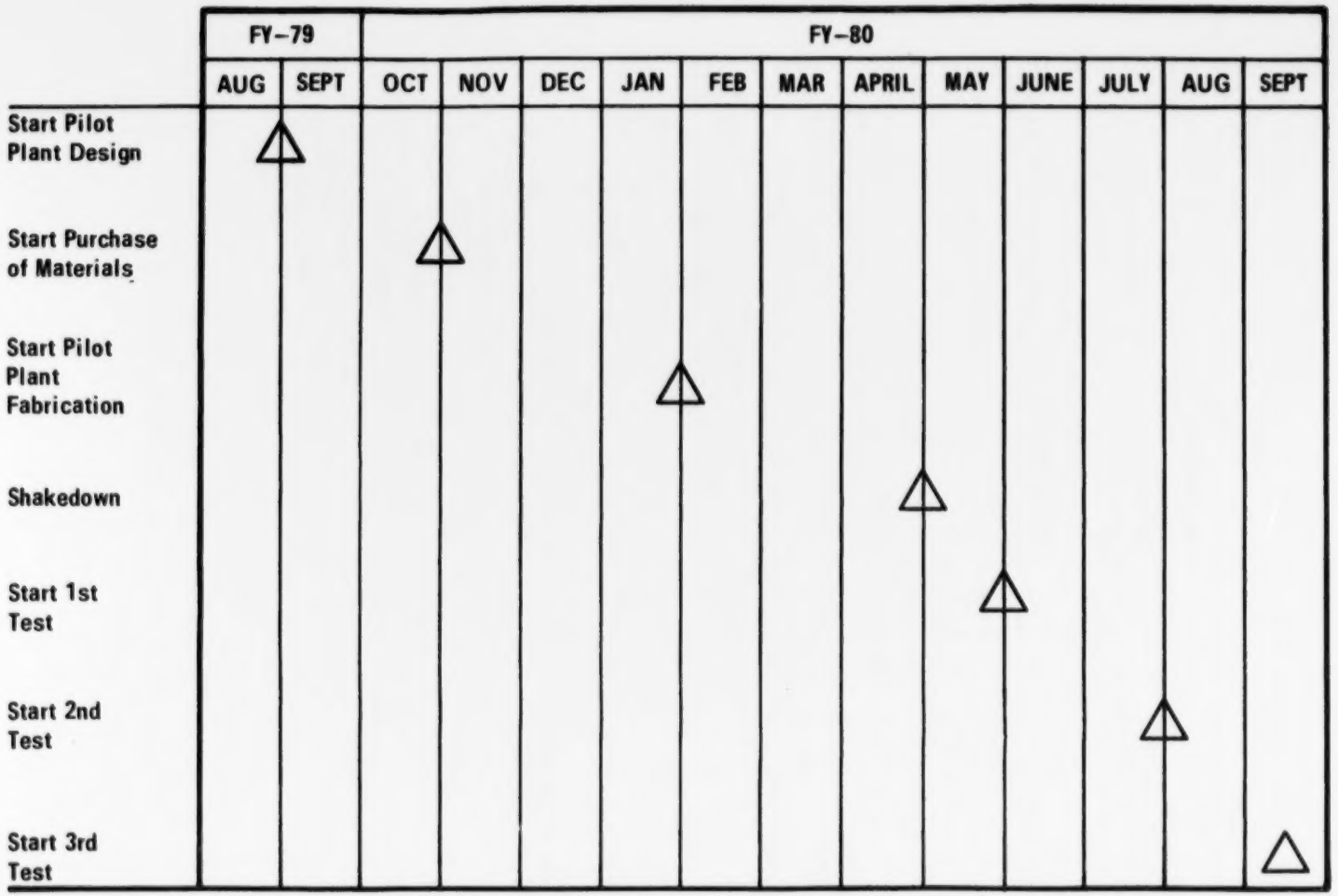

Figure 17: Project Schedule for Evaluation of Steam Stripping to Remove Toxic Organics from Wastewater

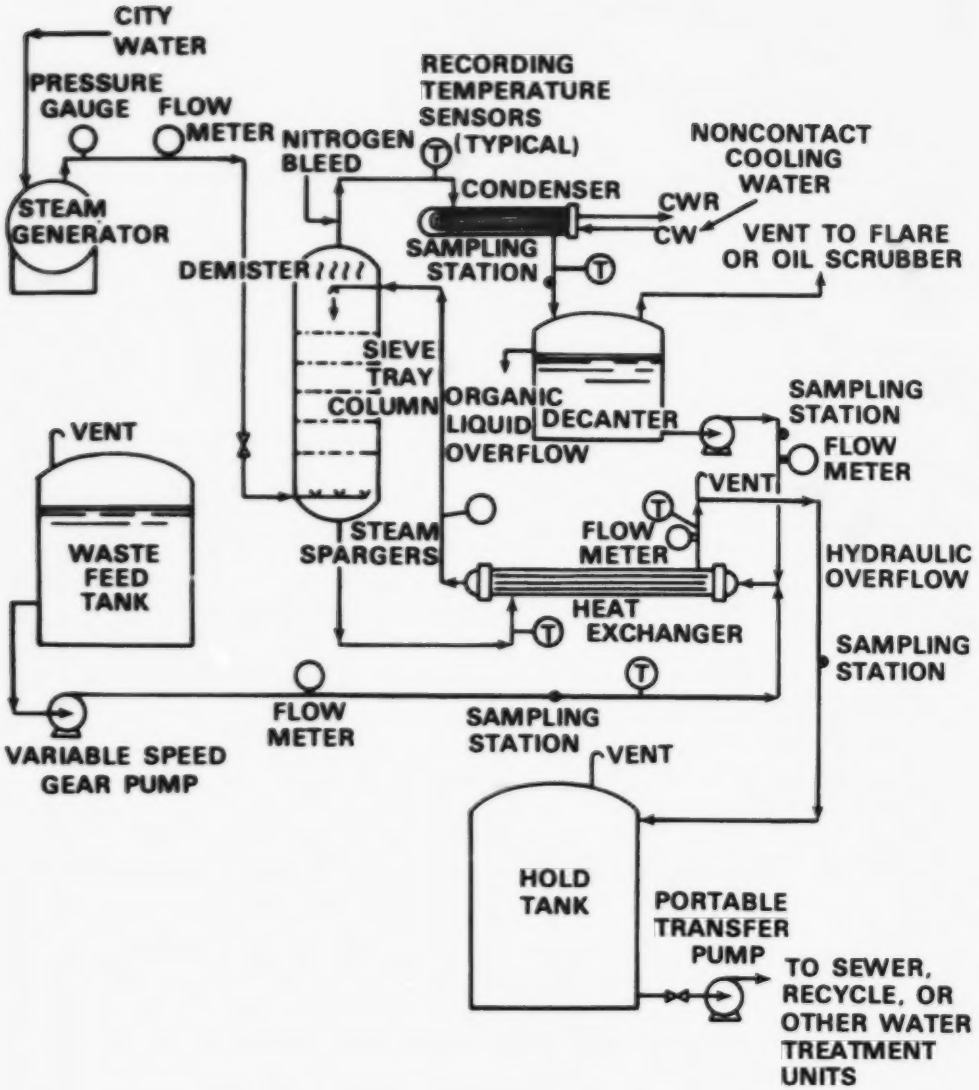

Figure 18. Flow Diagram for Evaluation of Steam Stripping to Remove Toxic Organics from Wastewater.

LEACHABILITY AND REVEGETATION OF SOLID WASTE FROM MINING

Objectives:

The objectives of this project are to determine the quality and quantity of leachate generated by the disposal of mining waste under various layering configurations, and to assess the vegetative uptake of potentially hazardous materials from the solid waste.

Fundamental Considerations:

The Extraction Technology Branch is currently participating in a study for the Office of Solid Waste to determine the environmental impact of solid waste from the phosphate, uranium, and metallic ore mining industries. As part of this study, the impact of these solid wastes on groundwater and surface water will be investigated. The leachability of potentially hazardous materials is of specific concern. To provide more detailed information, and to support field observations concerning the movement of salts in the wastes, pilot plant column studies will be conducted at the T&E Facility. Samples of wastes that are being studied in the field will be shipped to the laboratory for physical and chemical characterization prior to being placed in columns. Management practices similar to those used in the field will be applied to the columns. Since revegetation of mining waste is a common procedure for surface stabilization, grasses and legumes will be grown on a number of the test columns. The survival of this vegetation, the uptake of potentially hazardous materials by the plants, and the quality of leachate moving through the columns will be studied. This information may help to explain results obtained in the field studies, provide fundamental information on chemical and physical reactions, and verify the validity of full scale waste management practices.

Procedure:

Columns of mining solid waste or waste covered with soil material will be constructed in sections of pipe to simulate the conditions of reclaimed and unreclaimed waste disposal sites. Drainage ports at the bottom of the columns will allow for collection of leachate samples. A preliminary chemical analysis of the waste and cover soil for physical (size, pore volume, etc.) and chemical properties (nitrogen, phosphorus, potash, pH, SAR, heavy metals, etc.) will be made. Based on these tests, the nutrients needed to support plant growth will be identified. Fertilizer containing these nutrients and sufficient lime to adjust the soil pH to values normal for the plant growth will be added to the mine waste and will serve as a control column to demonstrate the success of growing plants on supplemented mine waste only. An additional control column will be composed of untreated mine waste with no vegetation.

Columns containing mine waste which has been supplemented and covered with up to four feet of soil material will demonstrate the usefulness of special cover material for improving the growth of vegetation, reducing leachate volume, improving leachate quality, and preventing the upward movement of acid and salts. Subsequently, columns containing layers of absorbing or non-absorbing materials such as charcoal, gravel, etc., will also be investigated for prevention of metal salt and acid movement through the soil.

On a regular basis, leachate samples will be collected and analyzed for critical parameters. Records of added water and leachate volumes will be kept.

Periodically, samples of vegetation will be taken from each of the columns. These will be analyzed to indicate the uptake of metal ions by the

plants. At the conclusion of the study, analysis of the cover material and waste at various depths will be made to determine chemical and physical changes. Of special interest will be accumulation of salts and potentially hazardous chemicals.

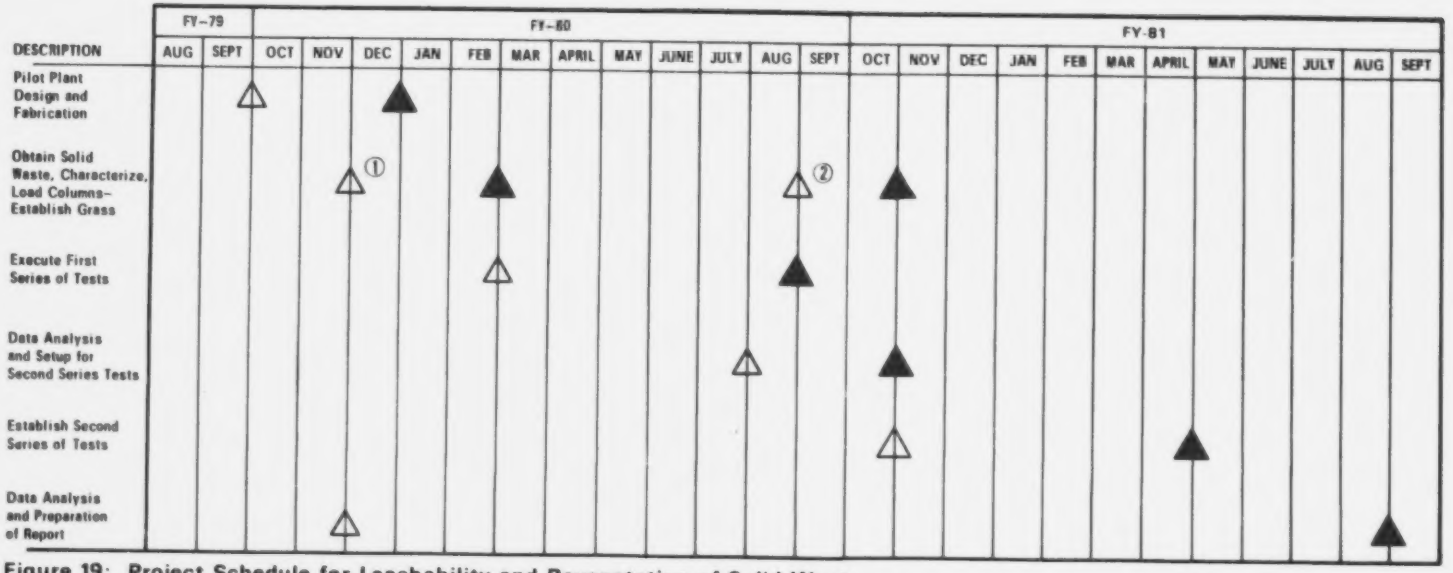

Figure 19: Project Schedule for Leachability and Revegetation of Solid Waste from Mining

△ Start Task

▲ Complete Task

① series 1

② series 2

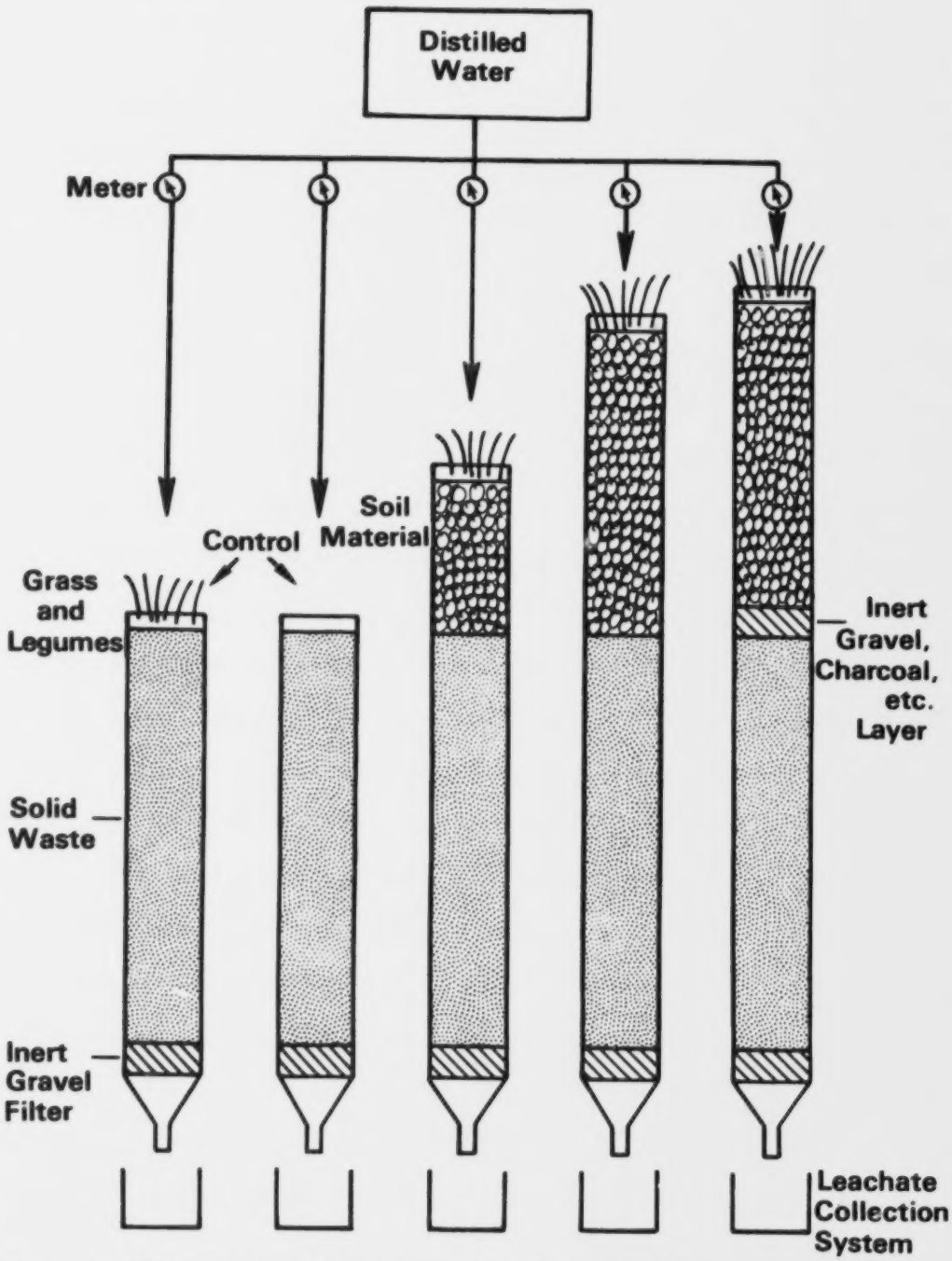

Figure 20. Example set-up for Leachability and Revegetation of Solid Waste from Mining

PILOT-SCALE CONVERSION OF MIXED/HAZARDOUS WASTES TO ENERGY

Objectives:

The objective of this project is to develop a feasible alternative to the improper disposal of hazardous and non-hazardous solid wastes by converting them into usable forms of energy, utilizing an existing fluidized bed combustion/pyrolysis test reactor.

Fundamental Considerations:

Laboratory, pilot-plant, and full-scale studies have been and are being conducted to identify product yields from the pyrolysis, partial oxidation, or combustion of various waste fuels. Specific waste fuels such as municipal solid waste, rice hulls, rye grass straw, cattle manure, and wood bark have been used in these studies, and the yields of various pyrolysis products at various operating conditions have been identified. In addition, various types of pyrolysis reactors, primarily affecting the time required to heat the waste fuel to the desired reaction temperature, have been used in these studies. Furthermore, various reaction products (gas, oil, char, etc.) have been recycled to the reactor as either a fuel or as process heat to further complicate the understanding of the pyrolysis process. As a result of these uncoordinated studies, there exists a body of knowledge related to product yields from specific waste fuels at specific operating conditions in specific reactor types. The extrapolation of this information to other type waste fuels at other operating conditions is difficult if not impossible. Furthermore, extrapolation to a mixture of waste fuels is even more difficult particularly with hazardous wastes.

A method is needed to predict product yields at various reaction conditions (temperature, time, etc.) with various product recycle rates for any

selected mixture of waste fuels. This method could be used by design engineers to select near optimum reaction conditions to achieve the desired product yields (based on local market conditions) from the waste fuels available that exist in a given geographical area. The pyrolysis system could be designed to use any or all of them depending on their impact on product mix, system economics, the potential other uses for the various waste fuels, etc.

To partially fulfill that need, a contract with Energy Resources Company (ERC) was supported by EPA for three years. During that time an extensive data base was established which led to the development of mathematical models to predict product yields utilizing a fluid bed reactor. This reactor, now at the T&E Facility, will continue such work with additional feedstocks/ combinations of feedstocks, particularly in the area of hazardous wastes.

The proposed project is designed to furnish a method to allow the selection of near optimum pyrolysis reaction conditions of time, temperature, reactor type, product recycle, etc., required to produce the most desirable mix of products from a mixture of waste feedstocks, particularly in the area of hazardous wastes, whose composition is known. The prediction method further developed and verified by this contract will be made available to the technical community for use in selecting pyrolysis, partial oxidation, or combustion conditions to adequately destroy selected hazardous wastes and to yield the most desirable product mix from the available mixture of waste feedstocks.

Procedure:

This project will be accomplished through a contract effort which is divided into the following four sub-parts:

1) Preparation of a test plan directed at accomplishing the stated objectives.

2) Modification and installation of the existing pyrolysis unit (located at EPA's Cincinnati Testing and Evaluation Facility) in such a manner as necessary to accomplish the stated objectives.

3) Conduct thermal destruction experiments.

4) Analyze collected samples, interpret the results, and provide conclusions, with supporting data, in a final report.

Modification and installation of the reactor will commence immediately after an approved test plan is developed. This will be followed by a brief shakedown period, all of which is scheduled to be completed five (5) months after the contract is awarded. After this is completed, the first phase of testing according to the test plan shall commence.

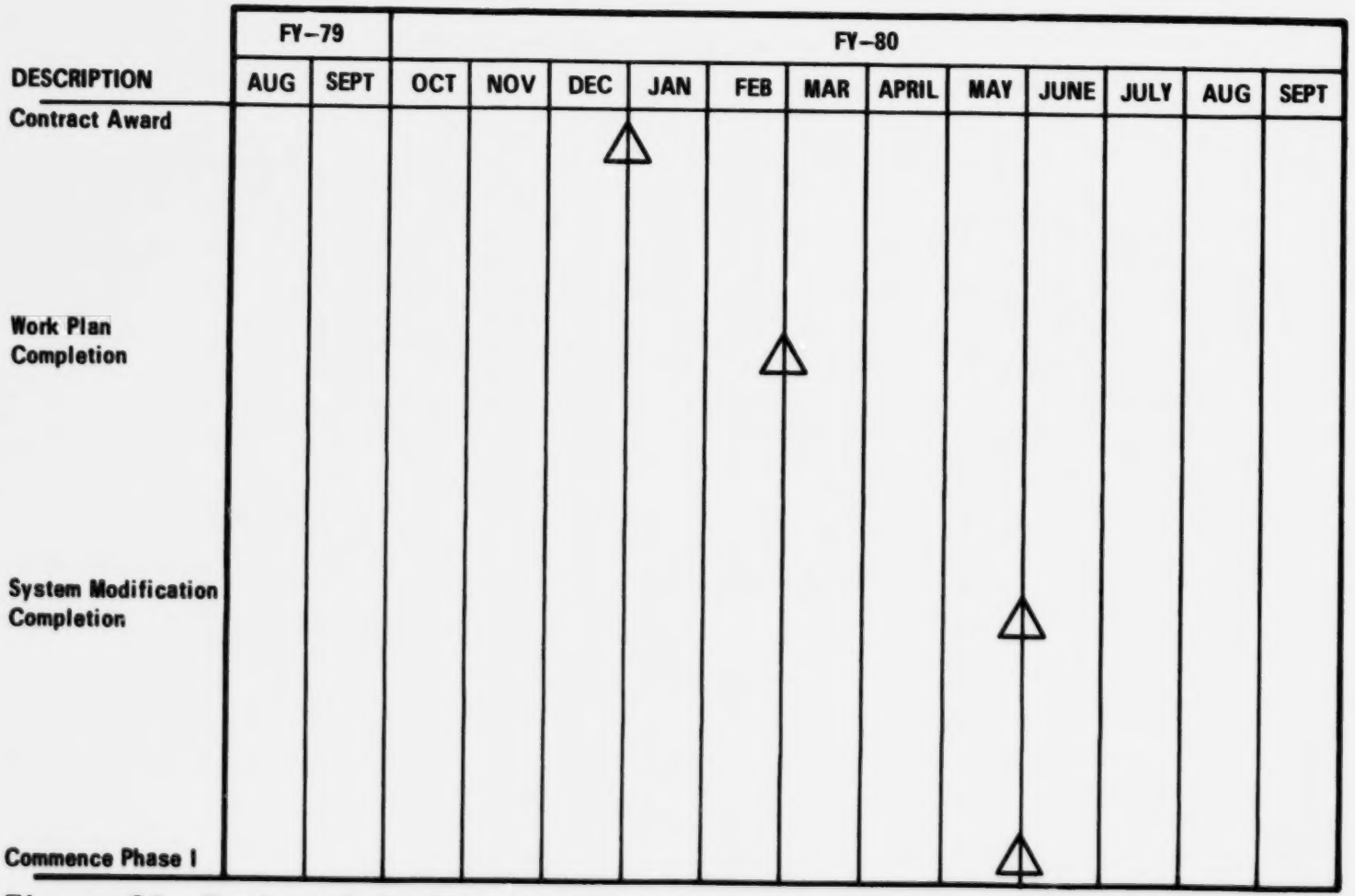

Figure 21: Project Schedule for Pilot–Scale Conversion of Mixed/Hazardous Waste to Energy

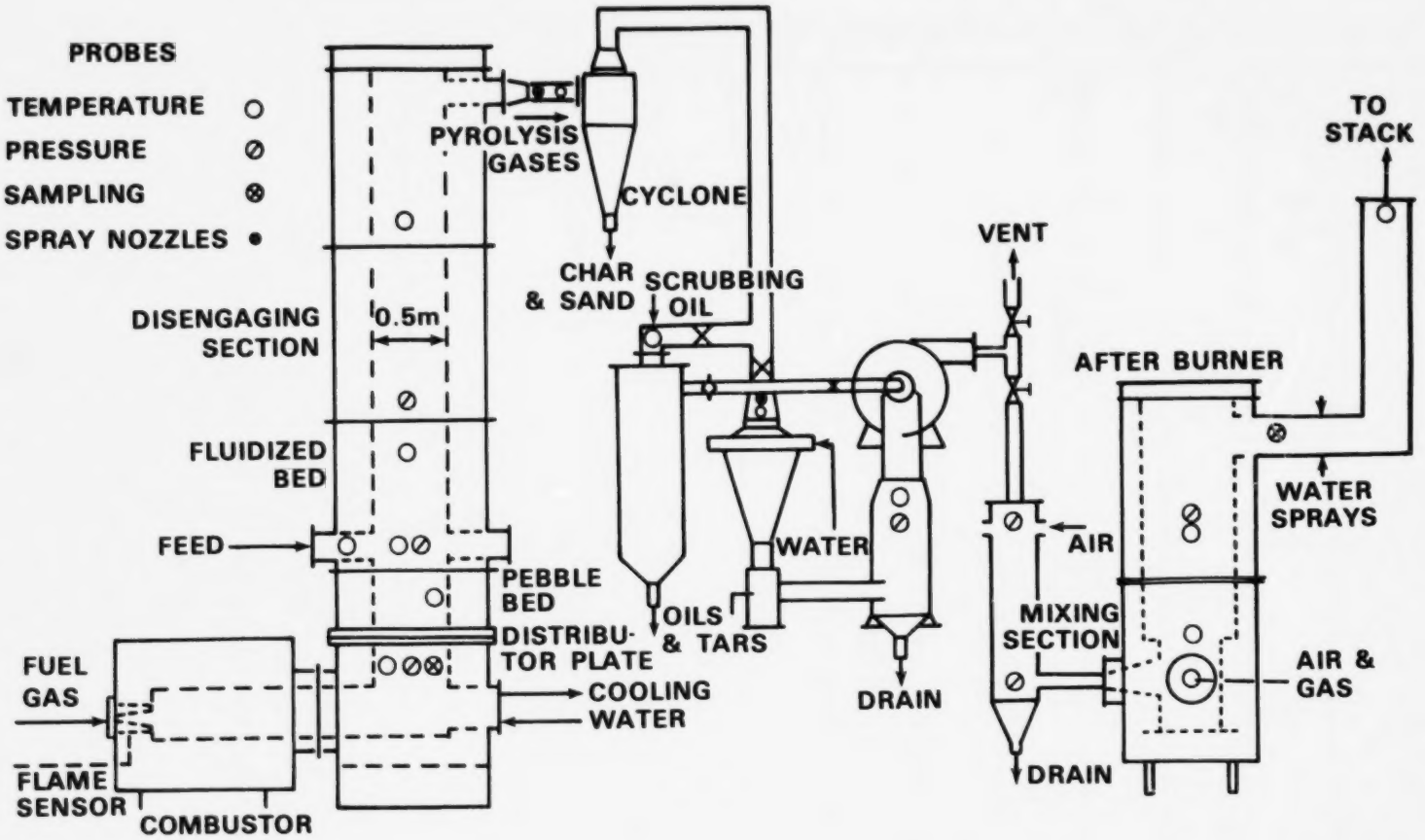

Figure 22. Flow Diagram for Pilot/Scale Conversion of Mixed/Hazardous Waste to Energy

THE ADSORPTIVE CHARACTERISTICS OF COAL: CONTROL TECHNOLOGY FOR IN-SITU COAL GASIFICATION EFFLUENTS

Objectives:

The objectives of this study are to evaluate the adsorptive characteristics of coal in removing trace elements generated during in-situ coal gasification.

Fundamental Considerations:

It has been stated many times that one of the chief concerns of in-situ coal gasification is the potential for water pollution. Organics, especially the polynuclear variety, are generated during pyrolysis and on at least one occasion have found their way into the groundwater. Inorganics, like ammonia, hydrogen sulfide, etc., have been found to increase in water exposed to gasified coal, char or ash. Trace elements like arsenic, mercury, lead, selenium and cadmium can be volatilized during retorting and find their way into the environment.

The study could address all of these considerations, but will be limited initially to the study of trace elements adsorption on coal.

Procedure:

A testing manifold will be constructed in which the thickness of the coal bed can be varied. Trace metals leached from a sample of gasified coal will be allowed to pass through the coal beds and the concentrations of the trace elements will be monitored.

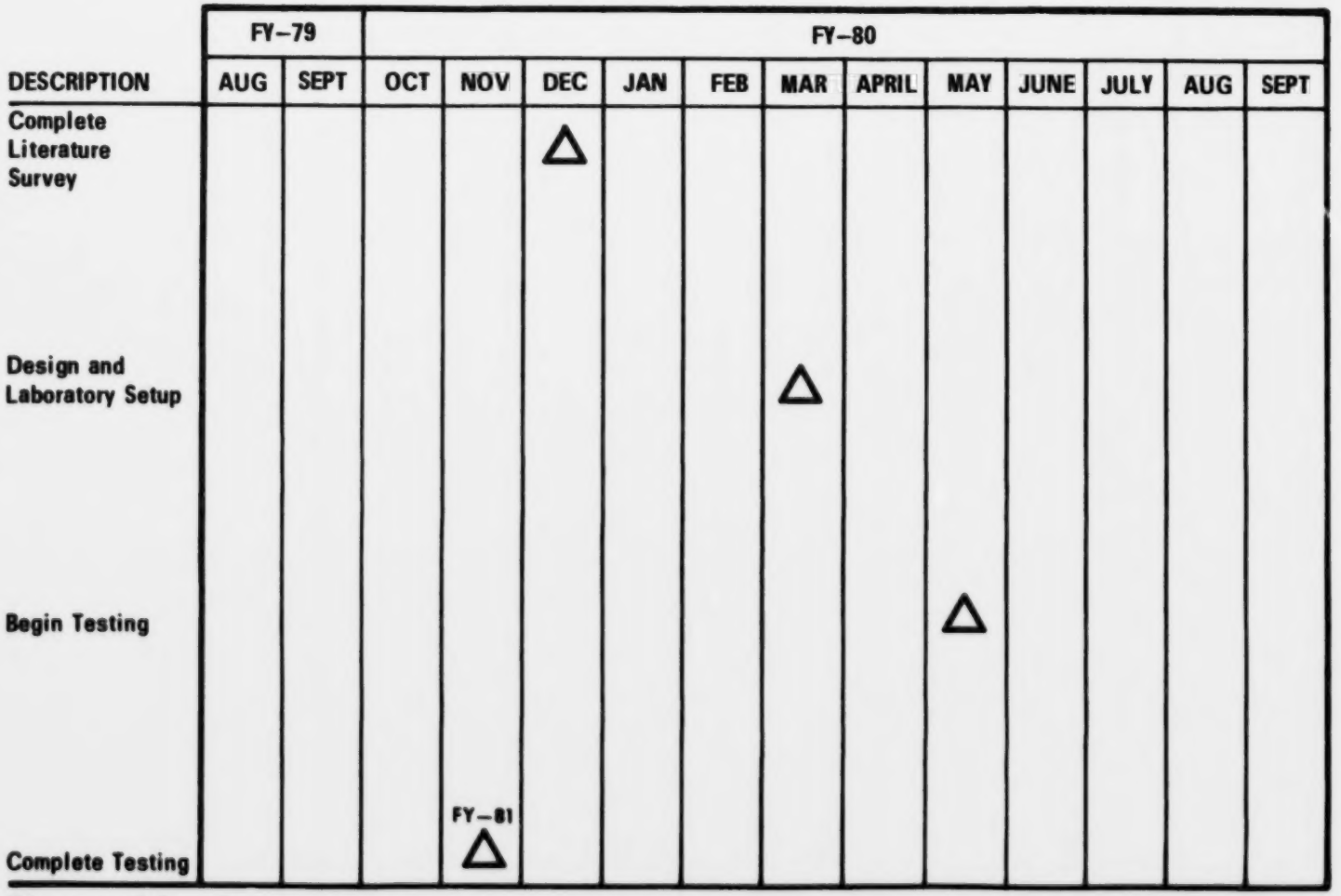

Figure 23: Project Schedule for the Adsorptive Characteristics of Coal: Control Technology for In–situ Coal Gasification Effluents

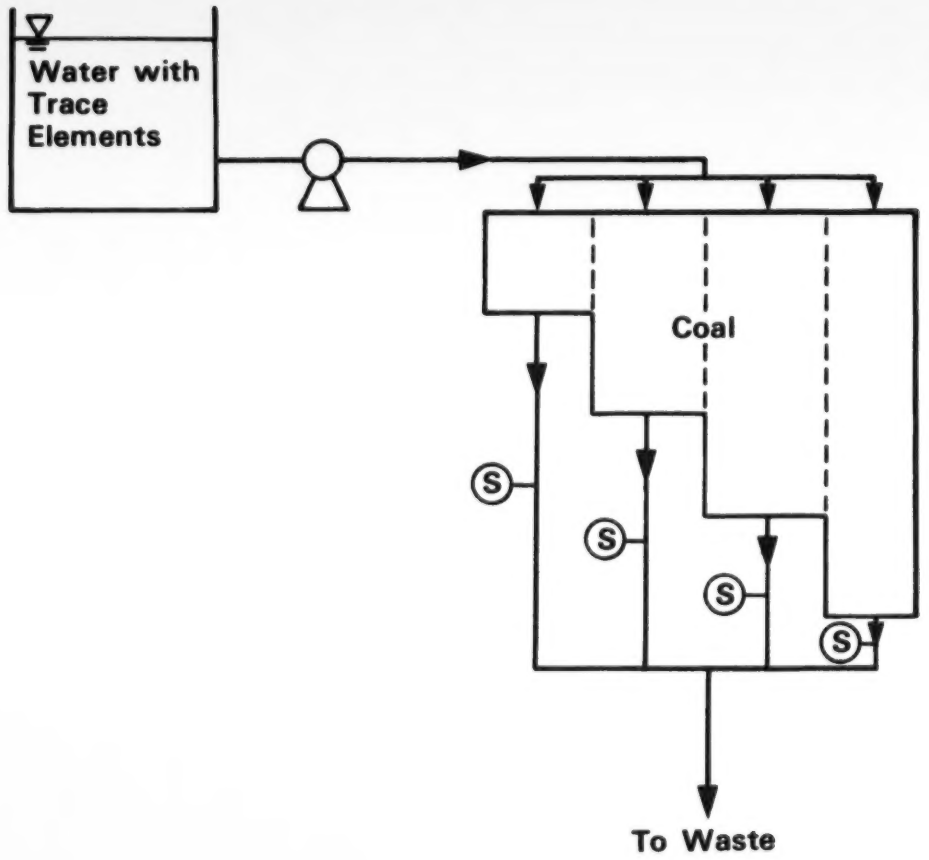

Figure 24. Flow Diagram for the Adsorptive Characteristics of Coal: Control Technology for In-Situ Coal Gasification Effluents

SHAKEDOWN OF VARIOUS UNIT PROCESSES FOR THE TREATMENT OF OIL SHALE WASTEWATERS

Objectives:

The primary objective of this project is to shakedown various existing devices or unit processes that have potential applicability to the treatment of wastewaters from the emerging oil shale industry. A mobile van is being equipped to house at least four such water pollution control pilot plants (trains) which will be used for on-site treatment experiments at oil shale operations in the West.

Fundamental Considerations:

The methods of pollutant removal from municipal and industrial wastewaters have been extensively researched in the field by EPA and others. It is necessary to develop the capability to evaluate various treatment methods in the field for a new emerging "energy" industry--oil shale. The program of which this T&E project is a small part will investigate all applicable treatment control technologies for oil shale wastewaters. That program will obtain testing equipment which is appropriate for field evaluation. Such equipment will be obtained through: (1) specific design and fabrication; (2) purchase of readily available, "off-the-shelf" units (5-10 gpm in size); (3) loan of any such applicable and available units; or (4) use of EPA's surplus lists.

Procedure:

Initially, two ion exchange units from the Crown, West Virginia, field station will be delivered to the T&E Facility in August of 1979. Preliminary information indicates that ion exchange, in combination with adequate primary

and secondary treatment unit processes, will be effective in removing metals and boron from some oil shale wastewaters. Consequently, these surplus units will undergo brief shakedown tests at the T&E Facility to determine their useability for subsequent field tests on oil shale wastewaters. Samples from influent and effluent will be analyzed to determine removal capabilities of these units for specific pollutants.

Project Schedule:

Determining the availability of mobile test equipment will be conducted under FTB's overall water pollution control technology development program and will continue through December of 1980. The shakedown of field equipment made available may continue on an intermittent, as-needed basis. The first specific wastewater field testing of oil shale effluents is scheduled for July of 1980. Figure 25 indicates the four phases of this project, as it blends with the schedule of the more comprehensive FTB program.

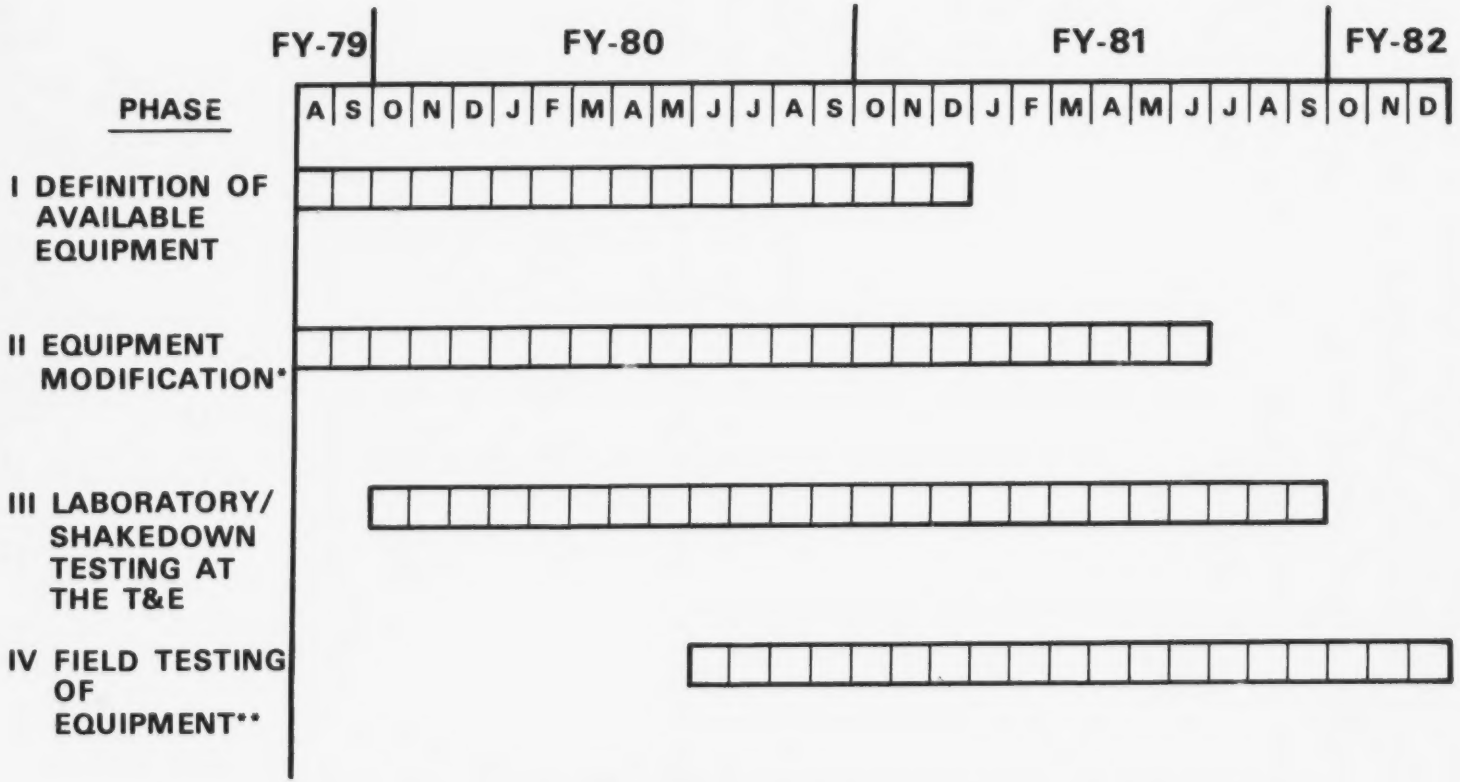
FY-79
FY-80
FY-81
FY-82
PHASE
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
I DEFINITION OF AVAILABLE EQUIPMENT
II EQUIPMENT MODIFICATION*
III LABORATORY/ SHAKEDOWN TESTING AT THE T&E
IV FIELD TESTING OF EQUIPMENT**

Figure 25. Project Schedule for Shakedown of Various Unit Processes for the Treatment of Oil Shale Wastewater.

*Done either at the T&E Facility or at Monsanto's Dayton, Ohio Laboratory
**Done elsewhere (not at the T&E Facility)